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NOTICE OF SOME HUMAN REMAINS FOUND NEAR THE CITY OF MEXICO.

BY MARIANO DE LA BARCENA.

IN the month of January, 1884, some excavations were being made, by means of dynamite, at the foot of the small hill known as "*Peñon de los Baños*," some four kilometers east of the City of Mexico. The excavations were made with the object of quarrying building stone for the Military Shooting School which is being constructed near the Peñon and under the supervision of Colonel Don Adolfo Obregon. This gentleman, at the beginning of January, was informed that among the rocks loosened by the dynamite some bones were to be found, and he accordingly collected and delivered them to the Minister of Public Works, Don Cárlos Pacheco, who appointed the writer to make a study of them. The preliminary examination being made, I presented them to the Mexican Society of Natural History, giving at the same time public notice of so important a discovery.

Some days afterwards I explored the formation in which the bones were found, continuing my studies with the coöperation of Don Antonio del Castillo, professor of geology, whom I invited to take part in my investigations; both making up a report which has lately been published in Mexico.

The human remains are firmly imbedded in a rock formed of silicified calcareous tufa, very hard and of a brownish-gray color. The cranium with the lower and upper maxillæ and fragments of the collar-bone, vertebræ, ribs and bones from the upper and lower limbs are exposed. The bones lie in disorder, proving that the rock in which the skeleton was found suffered an up-

heaval before consolidation, a circumstance which an examination of the ground further verifies. The bones present a yellowish appearance and the characteristic aspects of fossilization, it being noteworthy that they are not coated with layers of the calcareous rock as is observed in the recent deposits, but are firmly imbedded in the stone, which also fills the cells of the tissue.

Several distinct formations and rocks are seen in the locality where the bones were found; towards the center rises the small hill "*del Peñon*," consisting of volcanic porphyries; on the base to the north there appear first a clearly recent formation made up of vegetable earth, marl and ceramical remains, which in the upper part are modern, and in the lower belong to the Aztec ceramics. Under this recent formation are the calcareous layers in which the human remains were found.

These layers crop out with a rise toward the northern boundary, forming the end of an esplanade which surrounds the hill, and is three meters above the actual level of the waters of Lake Tezcoco. The layer of hardened rock does not extend with regularity the whole distance from the before-mentioned edge to the foot of the hill, some intervening spaces occurring in which this rock does not appear; the resulting hollows being filled with recent ground. This circumstance as well as the appearance of the layers of calcareous tufa, prove that this rock was upheaved after the deposit of the human bones, by the igneous rocks which crop out in the neighborhood of the hill forming dykes. This upheaval is also verified by the numerous smalls veins which are found in different directions on the ground.

In order to clearly establish the age which the deposit of the human bones might have, the best scientific method would be to find some animal fossil remains in the same formation which would distinctly mark the age of the layers of that calcareous rock, but until now, notwithstanding the many searches made, it has not yet been possible to find any traces of extinct animals; neither has there been found any vestige of ceramics or other remains that might indicate that these rocks were clearly modern, as among them the only things found were the human bones, roots converted into menilite and some small indeterminable lacustrine shells formed by the same calcareous substance. These shells belong to genera which have lived in Quaternary as well as present waters, it having been impossible to determine their species

on account of the bad state of preservation in which they were found.

In the region to the south of the hill more modern calcareous rocks are seen, and thicker deposits of recent ground with remains of Aztec ceramics.

Not being therefore able to utilize the palæontological data for determining the age of these calcareous layers, we must fall back on the inspection of the ground.

Two facts seem at once to reveal that even supposing the formation to belong to the present age, it must be of remote antiquity. These facts are: The elevation of the ground above the actual level of the Lake of Tezcoco, and the remarkable hardness of the rock in which the bones are found, different from the other calcareous rocks that contain remains of ceramics or roots of plants clearly modern. The upheaval of the lacustrine layers which contain the human remains might have taken place through the diminution and retirement of the waters of the lake, or by the upheaval of volcanic rocks.

In the first case it could have been occasioned either by a violent filtration of the water, or a slow evaporation; but nowhere in the valley of Mexico are any traces to be found of a crack or opening through which the waters could have escaped, and which ought to appear outside of the present level of the lake, as if it were below, all the water would have disappeared. If the lowering of level was due to evaporation, a theory which would be more admissible, because from the time of the conquest of Mexico to the present the submerged surfaces have notably diminished, the time necessary to have elapsed in order that the level of the lake might fall three meters to its present one, must have been very long. What is most probable is, that the upheaval is due to volcanic action; for although until now no basalt has been discovered immediately underneath the place occupied by the hardened layers, yet dikes of that rock are to be seen in different directions at the foot of the hill, and even the volcanic masses which constitute it are found upheaved and inclined, demonstrating the succession of geological phenomena in that vicinity.

Let us now trace the origin of the silicified calcareous rock in which the bones were found, and which is different from the majority of the lacustrine rocks which occupy the valley of Mexico, these latter being, for the most part, thick and extensive

layers of pumice, tufas, marls, volcanic ashes, clays and alluvions.

In order to proceed with more certainty in this investigation, I compared the calcareous rock in question with those which resembled it most from other parts of Mexico, and found it could only be considered similar to those which are clearly of a hydrothermal origin.

The hot-water spring which exists in the eastern part of the hill del Peñon forms sediments somewhat similar to the silicified calcareous tufa; but these are on a small scale and their formation is so slow as to preclude the belief that this spring could have filled all the immediate surroundings of the hill with deposits of such magnitude. What is most probable is, that in remote times there were great emissions of mineral thermal waters through different fissures, and in several directions, whose appearance was simultaneous with the basaltic masses that form dikes at the foot of the hill, as in the faces of the rocks sedimentations similar to the referred ones are perceived, there being furthermore many small veins which cut through the basaltic masses and even the calcareous rock.

By this it is seen that a series of volcanic phenomena must have taken place in that spot, beginning before the human remains were deposited, and which further continued when the material which received them was but little consolidated.

The succession of these phenomena took place, without doubt, in the following way:

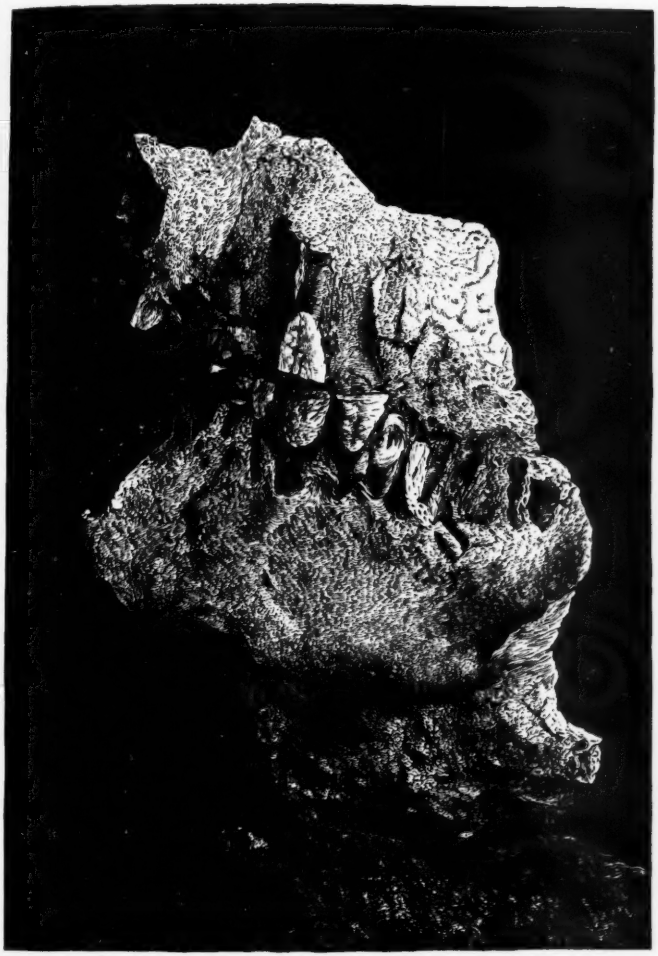
1st. Emission of thermal waters and appearance of basaltic rocks, upheaving the masses that formed the hill. These waters mixed with those of the lake which surrounded the hill and extended over a large area of the valley of Mexico; the calcareous deposits gradually accumulated around the hill, and being still soft the human corpse was deposited upon them.

2d. When the bones were already imbedded in the lacustrine deposit there came a new volcanic upheaval which raised this deposit, as the higher level which it now occupies proves, and the disorder in which the bones of the skeleton appear.

3d. In the gaps which were left after this upheaval, modern lacustrine deposits were formed, which increase even at the present time.

It is to be remarked that in other parts of the valley of Mex-

PLATE XXVI.



Another fragment of the maxilla of the fossil man of Mexico. From a photograph of the original by Cruces y Ca.

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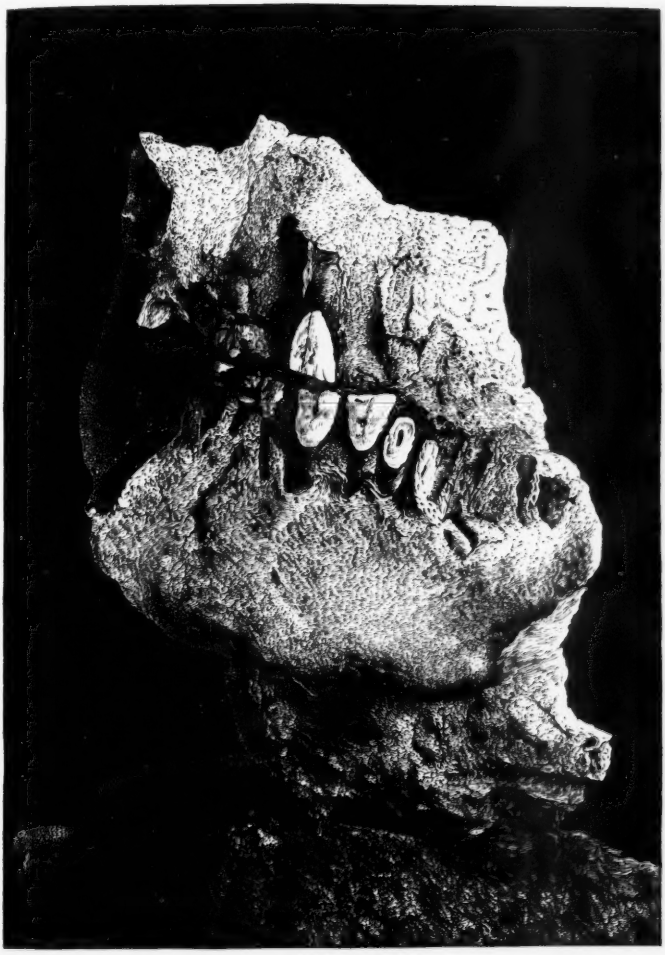

External view of left side and front of jaws of the fossil man of Mexico. From a photograph of the original by Cruces y Ca.

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ico in connection with the Lake of Tezcoco, isolated deposits of this silicified calcareous rock are seen, showing that the volcanic upheaval extended over a large surface, and that the thermal waters appeared several times. One of these deposits is to be found at the height of two meters above the present ground among rocks of the hill *del Tepeyac*, north of the City of Mexico.

The geological circumstances of the event once determined, and notwithstanding that the palæontological data are wanting that might mark with precision the relative age of that deposit, it is to be believed that it must be of remote antiquity, considering the circumstances which the mentioned rocks present, as well as the geological phenomena which have there taken place and of which no notice is given in the hieroglyphics or traditions of the ancient Mexicans.

This consideration alone is enough to believe that the man of the Peñon is prehistoric The odontological characteristics indicate that this man belonged to an unmixed race, the teeth being set with regularity and corresponding perfectly the upper with the lower. They present the peculiarity besides, that the canine teeth are not conical, but have the same shape as the incisors; a peculiarity which has been observed in other teeth found in very ancient graves of the Toltecs.

The size and shape of the bones of the limbs are those corresponding to a man of ordinary stature, and from the appearance of the teeth the man must have been about forty years old.

The greater part of the cranium having been destroyed, it was not possible to determine its diameters and thus classify it. The stratigraphical and lithological characteristics of the ground seem to indicate that the formation belongs to the upper Quaternary or at least to the base of the present geological age.

It may as well be remarked that at the foot of the steep slope of the Tepeyac hill, near the place where the calcareous sediments are to be seen among the rocks of the hill, as was previously mentioned, some excavations were made, and Professor Don Antonio del Castillo found various bones of Quaternary animals enveloped in a calcareous rock similar to that of the Peñon. The distance between this hill and the Tepeyac is nearly three miles.

The excavations continue at the foot of the hill del Peñon, with

the object of quarrying building stone, and this will allow in the course of time some other data to be discovered which will clearly mark the geological age of the event; a tooth of a mastodon or an object of the present age would at once be the landmark assigning it a fixed page in the history of the earth. The authenticity of the fossil is not only determined by the report of Señor Obregon and the identity of the rock which contains the remains with the blocks that are being at present quarried at the foot of the hill, but I, myself, have determined this authenticity, having found part of the human remains still imbedded in the ground rock.

I will conclude by mentioning other facts that indicate the antiquity of man in the valley of Mexico. Twelve years ago, in executing some works for the drainage of the valley, in the direction of Tequisquiac, numerous deposits were discovered belonging to Quaternary animals, such as elephants, mastodons, glyptodons, etc., and among one of these deposits a fossil bone was found carved by human hand and imitating an animal's head. Unfortunately no care was taken to determine if it was found simultaneously with the bones of the Quaternary animals. The appearance of the carved bone and of the cuts and incisions which it has, denote a remarkable antiquity, and it has characteristics of fossilization. Two years ago I discovered some remains of ancient ceramics in the pumice tufa which is under the basaltic lava formation found in the south-eastern part of the valley of Mexico; the lava occupies a large area, and in some points its thickness is over two meters. No tradition makes any mention of this volcanic cataclysm before the existence of man in the valley of Mexico.

These are, at present, all the data I can give relative to the man del Peñon. On my return to Mexico I will continue with a further investigation of the ground where the discovery was made, and will communicate anything new that may be found, in order to determine the anthropological importance which these human remains may have.

EVOLUTION IN THE VEGETABLE KINGDOM.

BY LESTER F. WARD, A.M.

(Continued from p. 644, July number.)

II. Geological View.

The most ancient fossil remains that have been referred to the vegetable kingdom are two species of Oldhamia from the Cambrian deposits of Ireland, but the vegetable character of these forms has been latterly called in question. From the Lower Silurian forty-four species, chiefly marine algæ, have been named. Among these, however, are included the earliest terrestrial forms. Not to mention the problematical *Eopteris morierei* of Saporta, we have *Sphenophyllum primævum* Lx., and two other vascular plants from the Cincinnati group. In the Upper Silurian thirteen species are recorded, five of which are vascular plants. One of these is *Cordaites robbii* Dawson, found in the Silurian of Hérault as well as in the Devonian of Canada. The Devonian furnishes 188 species of fossil plants, while from the Permo-Carboniferous nearly two thousand species are known, or nearly nine-tenths of the entire Palæozoic flora.

With the Mesozoic a great diminution appears in the abundance of vegetable life that has been preserved. Only sixty-seven species have been found in the whole of the Trias. With the Rhætic a new impulse is felt increasing through the Lias and reaching a second but much reduced maximum in the Oölite, from which 419 species are recorded. The wave then again recedes until the close of the Gault is reached.

The Cenomanian of Europe, with the beds of Atane in Greenland and the Dakota group of the United States which probably correspond to it, mark a new epoch, supplying together nearly five hundred species of fossil plants. That member of the Cretaceous formation which immediately overlies the Cenomanian, viz., the Turonian, to which the Fort Benton group of American rocks seems to belong, is almost destitute in both countries of vegetable remains, but with the Senonian we meet again the increasing volume which was merely interrupted by unfavorable conditions for the preservation of plants. Here we have in European strata, in Patoot, Greenland, and in British Columbia 354 species. Although none have yet been described from this horizon within the territory of the United States, I have myself demonstrated

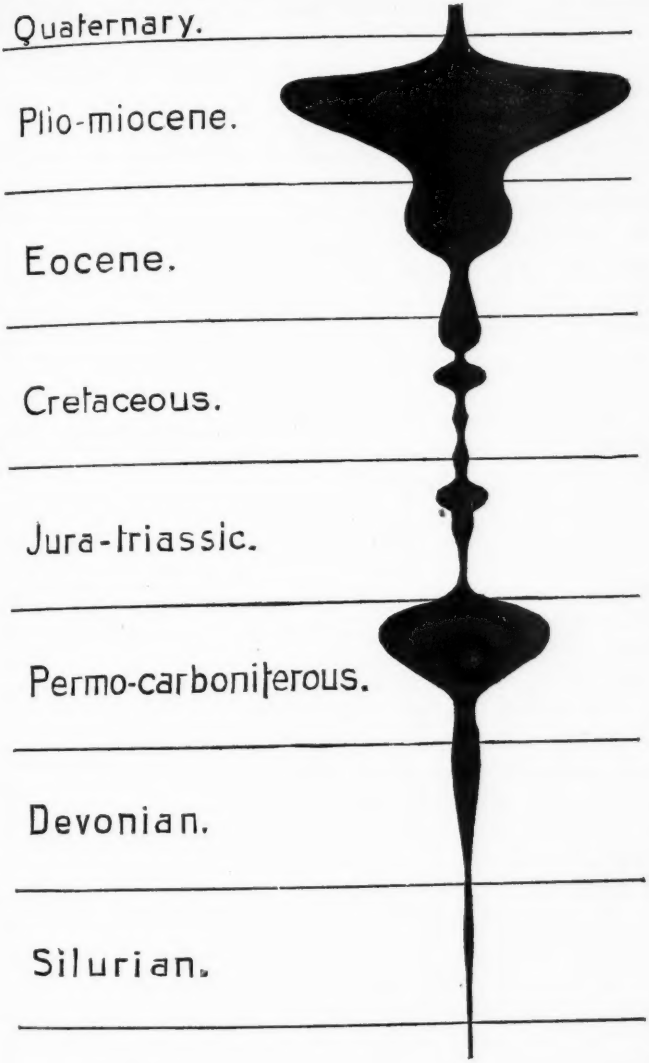
their existence to a limited extent, and live in hopes of yet bringing to light an important Upper Cretaceous flora.

We are thus brought to the Laramie group of the Western Territories, which, though a brackish water deposit and difficult to correlate with other deposits, may be regarded as extreme Upper Cretaceous; 333 species have been thus far described from this group, which presents a flora of a still more Tertiary aspect than that of the Senonian proper, and fittingly ushers in the Tertiary flora.

From the Paleocene of Sézanne and Gelinden to the Miocene the progress is uniform and rapid. The Eocene of the old world (Paris basin, Aix in Provence, Monte Bolca, Monte Promina, Monte Pastello, Isle of Wight, London clay, etc.) furnishes over 650 species, while the Green River group of America, including the rich beds of Florissant, Colorado, probably of that age, has yielded more than two hundred. This is exclusive of the so-called Oligocene of the continent (Hæring in Tyrol, Sotzka in Carniola, the Marseilles basin, Armissan near Narbonne, etc.) from which nearly 800 more have been taken. We thus have over 1800 pre-Miocene Tertiary plants, which is, however, much less than half of the Tertiary flora. The Miocene supplies nearly all the rest, yielding alone over 3000 species. It may be, as has been charged, that this number is too great, and that a portion of these plants belong to lower horizons. While Heer's determinations in Switzerland have not been seriously questioned, his work on the arctic floras is doubtless open to revision, but this will not diminish the number of Tertiary plants, which, if we add to those already mentioned some 150 Pliocene species, will form an aggregate of nearly 5000.

The Tertiary virtually closes the series for vegetable remains, the Quaternary having thus far furnished less than one hundred species of fossil plants.

The development of plant life through the successive geologic ages may be graphically represented, so far as indicated by actual discovery, by the accompanying diagram or figure, in which the number of accredited species is taken as a measure of predominance, and the space assigned to each horizon in the vertical scale represents its duration in so far as the thickness of the deposits can be regarded as a measure of time.



The fact is thus brought clearly to view that there have existed

two favorable periods for the preservation of vegetable remains —the Carboniferous and the Miocene—the wide interval between which is relieved by two less favorable periods culminating in the Oölite and the Cenomanian respectively. To what extent the intervals of great scarcity may yet be filled, it is impossible to predict, but it is well to remember that it is only quite recently that the Oölite has assumed prominence as a vegetable deposit, and this chiefly through researches made in India and Siberia. With the further development of such outlying regions it is to be hoped that a much greater degree of uniformity in the different geological periods will be secured. But of this there is no certainty, and it is perhaps equally probable that future research may tend to exaggerate the present extremes.

Three things must combine for the successful development of a fossil flora in any given geological formation: 1. The requisite vegetation must have flourished at the period in question; 2. the conditions for its preservation and subsequent exposure must have existed; and 3. the localities in which it is imbedded must be found and worked. As regards the first of these conditions, we know that great fluctuations of the land surface of the globe have taken place, and periods may have been passed during which these were much less in amount than at others. Still, there can be little doubt that the variety at least, if not the abundance of vegetation, has undergone a somewhat uninterrupted increase since the earliest times. The second condition is a much more serious one. Immense periods may have elapsed without any record being made, not because vegetation was scarce, nor because land areas were limited, but because, as seems now to be the case over most of the globe, all vegetation was allowed to decay and return to the atmosphere. Again, vast beds may have been deposited but never afterward raised up and exposed, and may remain forever inaccessible. It is only the third condition which it is within the power of man to influence. But when we consider the accidental manner in which a great part of such discoveries have been made thus far, we may well presume that the most precious scientific treasures which the earth holds may remain undiscovered indefinitely although within the easy reach of the investigator.

III. Botanical View.

Most of the plants of the Palæozoic age belong to archaic types long since extinct and having only very much modified

living representatives. This is less marked in the ferns than in those forms which have as their nearest modern descendants the Equisetaceæ, the Lycopodiaceæ and the Coniferæ. The Palæozoic ancestors of the Equisetaceæ are the Calamariæ, having the genus Calamites for their typical form. Those of the Lycopodiaceæ are the Lepidophytes with Lepidodendron as their type, while according to the most recent researches the Coniferæ had as their ancestral form the Cordaiteæ, long classed among the Cycadaceæ, with Cordaites as the principal genus.

As a means of expressing the fact of this prolongation of living forms through the geologic periods and of denoting the probable descent of modern from these archaic types of vegetation, the terms Filicineæ, Equisetineæ and Lycopodineæ have been employed as broader than the corresponding ordinal designations in common use. The Marquis Saporta has sought to accomplish the same object for the Coniferæ by the term Acicullariæ, but this unfamiliar substitute will not be likely to meet with general acceptance.

The cellular cryptogams, which, admitting Oldhamia to be a plant, had two representatives in the Cambrian, constituted the principal vegetation throughout the Silurian. Yet the ferns, if we accept Saporta's Eopteris, the Equisetineæ and Lycopodineæ, all had their origin in the Lower Silurian, while the Coniferæ, through Cordaites, made their appearance in the Upper Silurian.

Three species of Rhizocarpeæ (Sporangites, Protosalvinia) have been described by Sir J. W. Dawson from spore-cases detected in Devonian rocks of both Canada and Brazil. Heer had already mentioned, in 1874, what he regarded as the fruit of some rhizocarp from the Lower Carboniferous of Spitzbergen, and there can be little doubt that many of the spore-bearing plants of the coal measures belonged to this order, although none have been described from the Carboniferous proper. This little group, which has been supposed in a manner to mark the transition from the cryptogams to the gymnosperms, reappears, according to Heer, in the Oölite of Siberia, the Urgonian of Kome and the Cenomanian of Atane, Greenland. It occurs in our Laramie and Green River groups, in the Oligocene of France, and in the Miocene of Switzerland and Central Europe.

With the true Carboniferous two new types appear—the Cycadaceæ and the monocotyledons. If, with Grand'Eury, we rele-

gate the Medullosæ to the ferns, the former of these types has a meager representation, but Renault admits Cycadoxylon in that formation, and *Cyclocladia ornata* occurs at Saarbrücken, while Schenk finds a true Pterophyllum in the coal flora of China.

The presence of monocotyledons in the Carboniferous was long disputed, based as it was upon certain palm-like trunks described by Corda from Radnitz. But we now have one species of Palæospathe whose monocotyledonous character has not been questioned. The problematical sporangium, too, formerly supposed to occur no lower than the Permian, has now been found in the Carboniferous of St. Etienne, of Wettin, of Mazon creek, Illinois, and of Pittston, Pennsylvania, while so skeptical an author as Nathorst, in one of his latest works, defends its claims to be called a monocotyledon.

Thus we find that all the leading groups or types of vegetation, except the dicotyledons, had made their appearance at the close of the Carboniferous age. Before passing to that important subclass of the vegetable kingdom, the Ligulatæ and the Gnetaceæ, though numerically unimportant, deserve notice because they have been regarded by some as transition forms connecting the great types.

The Ligulatæ are allied to the Lycopodiaceæ, and the genus Selaginella has sometimes been placed in the one and sometimes in the other of these orders. It is claimed to have been found in the Carboniferous, but of this there is doubt. Its first certain appearance is in the Cenomanian beds of Atane, Greenland, but it also occurs in our Laramie group at Golden, Colorado, and at Point of Rocks station in Wyoming Territory. The more typical ligulate genus, Isoetes, makes its first appearance in our Eocene at Florissant, Colorado, and is represented by two Miocene species in Europe.

As regards the Gnetaceæ, by far the most ancient known representative is Heer's *Ephedrites antiquus*, from the Oölite of Siberia. Only two other fossil species of this order are known, viz., *Ephedra (Ephedrites) sotzkiana* (which not only occurs in the Oligocene of Sotzka, but in several of the principal Miocene beds of Switzerland, Germany and Austria) and *Ephedra johniana* from the amber deposits of Samland, Prussia.

The immense interval of time that separates the first appearance of all other forms of plant life from that of the dicotyledons

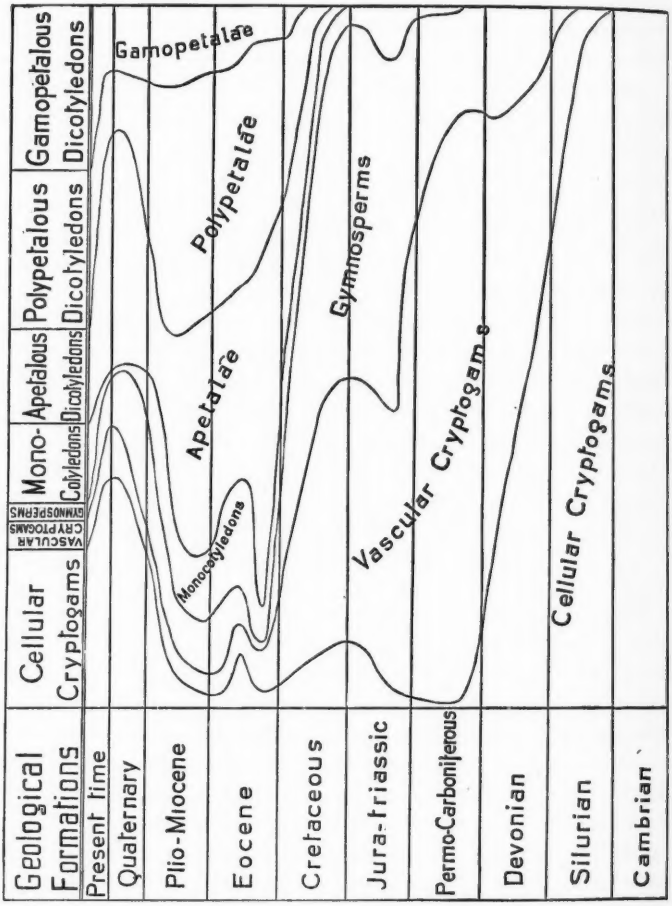
is one of the most striking facts revealed by palæontology. Heer's *Populus primæva*, from the Urgonian of Pattorfik, Greenland, described ten years ago, still remains the sole representative of this sub-class in any formation below the Cenomanian and the most ancient dicotyledon known.[1] Not less remarkable, however, has been the march of these plants since their earliest manifestation, as will presently be shown.

Having thus noted the time of first appearance of each principal type of vegetation, we may now hastily glance at the mode of subsequent development of each. This might be done from two distinct points of view, the absolute and the relative, but as the former would be powerfully affected by the defects in the geological record, no attempt will be here made to represent it graphically. The relative point of view, however, admits of such representation which in a certain respect eliminates these defects. Collectors of fossil plants do not seek specially for particular types. They take all they find, and hence if the chances of preservation are equal for all types the chances of finding plants of a particular type would depend upon its abundance in the flora of the epoch to be studied, while conversely, the degree to which any type of plants is represented in collections would be a fair measure of its abundance in the flora of the given epoch. The accompanying diagram is based upon this assumption, and clearly shows the progress of each of the leading types.

The facts sustain in a striking manner the early generalization of Brongniart, against which Dr. Lindley so strongly inveighed as late as 1836, that there has been a general upward tendency in structural development through the geological periods. The Silurian was the age of cellular cryptogams, consisting principally of marine Algæ. The reign of the vascular cryptogams began with the Devonian and closed with the Permian, the ferns constantly taking the lead but being strongly supported by the Calamariæ and Lepidophytes throughout the Carboniferous. The gymnosperms assumed supremacy in the Trias, the Cycada-

[1] Fossil wood supposed to possess the dicotyledonous structure has several times been found in lower formations (see J. G. Kurr's "Beiträge zur fossilen Flora der Jura-formation Württemberg," Stuttgart, 1845, page 9; Sorby "On the occurrence of non-gymnospermous exogenous wood in the Lias near Bristol," Microsc. Soc. Trans., III, 1852, pp. 91–92), but evidence of this class is not yet accepted as conclusive.

ceæ taking the lead in the Keuper and holding it through the Oölite, then surrendering it to the Coniferæ, which held it far up into the Lower Cretaceous. The monocotyledons never held a dominant position but increased steadily throughout the Meso-



zoic, reaching their highest expression in the palms and their greatest relative predominance in the Eocene, but probably attaining their highest absolute development in the Oligocene or Lower Miocene. The dicotyledons, which, as already shown, made their first observed appearance in the Urgonian, or Lower Cretaceous,

progressed with such amazing rapidity as to become the ruling type in the Cenomanian, or Middle Cretaceous, furnishing in that formation over seventy-two per cent of the total known flora of the globe, which is nearly as high a percentage as they attained at any subsequent period. Of the present flora they form less than sixty per cent, and doubtless their relative position in the fossil flora is exaggerated, owing to the failure of the myriad fungoid forms, existing then as now, to leave any traces in the rocks.

The systematic value of the prevailing subdivision of the dicotyledons into monochlamydeous and dichlamydeous, and the latter again into polypetalous and gamopetalous, diminishes with the progress of research. The first of these divisions is invalidated by the fact that the natural affinities are between apetalous and polypetalous and not between apetalous and gamopetalous plants, the last named division being the highest in point of structural development. The apetalous division forms forty-five per cent of the dicotyledons in the Cenomanian, thirty-seven per cent in the Miocene and only fourteen per cent in the living flora. The polypetalæ are fifty per cent in the Cenomanian, forty-eight per cent in the Miocene and forty per cent in the living flora. The Gamopetalæ are five per cent in the Cenomanian, fifteen per cent in the Miocene and forty-six per cent in the living flora. Making all due allowance for the fact that the Gamopetalæ of the living flora are more largely herbaceous than either of the other divisions, which fact, properly viewed, constitutes a strong proof of their greater recency, this evidence would seem quite sufficient to establish the order of development of the dicotyledons as here arranged.

As still further confirming the general law of development in vegetable life, we observe the great decline of the cryptogamic types that predominated throughout the Palæozoic. The same is true to a less extent of the gymnosperms, and notably of the Cycadaceæ. The monocotyledons have also probably declined, as have the lower or monochlamydeous dicotyledons. The only one of all the leading forms of life of which we can positively say that it still preserves an upward tendency is the gamopetalous division of the dicotyledons, which, unless arrested by human agency, seems destined to form the dominant type of vegetation or the next geologic epoch.

THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 691, July number.)

III. Development of the Nervous Function.

IN the last section the mechanism of the nervous system was considered. The modes and causes of its special development, and particularly the influences controlling the evolution of the cerebrum, now call for consideration. As already said, consciousness may, for all we know to the contrary, attend every nervous manifestation. But consciousness in that clearly defined and centralized condition which we call the psychical is the outcome of a long era of development through which the nervous mechanism has attained a high degree of specialization. At first excessively vague and faint it gradually grows stronger and more definite, until it reaches its ultimate in the vigorous, clearly defined and highly developed consciousness of man.

This result has been in great part an outgrowth of the growing sensitiveness of animal life to external energy. In the lowest forms this sensitiveness is undoubtedly very slight. In the Protozoa it is probable that touch is the only sense that has any degree of strength, though it seems evident that these animals are somewhat affected by influences emanating from substances at minute distances. Whether the vague sensations which attract the Protozoa to their food arise from physical emanations of the nature of smell, or from some heat or light influence, cannot well be determined. In many of the lower Metazoa there is no indication of any superior sensory powers. In sessile forms, indeed, the powers may be yet lower. The sponge, for instance, may possess only the sense of touch, resident mainly in its cilia. The fixed polyps may possess no higher sensitiveness, though in the free forms, such as the Medusæ, there is an evident display of more varied and delicate sensitiveness.

Yet in all the lower forms of animal life one thing is evident. External energy does not force its way into the body in any very great quantity, and it is quite possible that every sensation may call forth a motor response. This, indeed, seems to be the case in yet higher forms of life. The sensations are so limited in number that there can readily be a motor response to every sensation, and there is no reason why there should be a change from

the primitive system of direct and immediate communication between the organs of sensation and the organs of motion. If in these forms intermediate ganglia exist, their sole duty may be that of a division of the current of energy and the drafting it off to the proper muscles.

As we ascend to higher forms of animal life, however, a more developed sensitiveness appears. This is a necessary result of animal development. Higher life conditions require superior powers of perceiving prey or enemies, and greater quickness in pursuit or flight. For this, sensitiveness to more and more distant impressions, to more delicate conditions of energy, and to a greater variety of emanations becomes requisite. The originally general sensitiveness must become specialized, and the nerves attain varied endings suitable to the reception of diversified modes of vibration or contact.

This absolutely necessary consequence of the development of animal form yields another consequence of considerable importance. If the sensory organism becomes highly developed and capable of receiving delicate impressions both from near and far, the inflow of energy must become so great and continuous that a motor response to every sensation will become impossible. There must be some means of checking the inflowing current and preventing the whole of it from reaching the muscles, or the body will wear itself out from the very superiority of its organization. If the sensory currents be permitted to reach the muscle fibers these cannot but respond, and would thus be steadily in the condition of fatigue and incapability. It necessarily follows that a full development of nervous susceptibility is impossible unless in some method the excessively numerous external energies which beat upon the body can be prevented from bringing all their force to bear upon the muscles.

This is the secondary phase in the development of the nervous function, and nature has chosen two methods of attaining the requisite end. In the one case, as the nervous substance grows more susceptible its sensitive terminations are covered by an indurated material, through which energy cannot readily force its way. The special organs needed to receive the more delicate forms of energy are developed only on limited tracts of the body, and touch and temperature alone are capable of affecting the whole surface. With the great mass of animals the effects of

temperature are checked by some sort of protective covering, while largely in the Invertebrata, and to some extent in the Vertebrata, the effects of touch are diminished by a thick armor of scales, horn or shelly matter. In the sessile and inactive forms only a small portion of the body is usually exposed to sensory influences, the remainder being incased in solid armor through which no ordinary impression can penetrate.

As animals grow superior in organization, however, the need of swift and varied motion renders this hard covering a disadvantage, and it is thrown aside, exposing the whole body to the assaults of energy, while the organs of special sense grow constantly more and more delicate and varied in their susceptibility. In these cases, then, the body is invaded by an enormous multitude of sensory currents, which, could they all reach the muscles, would cause a serious loss of physical energy. To check this inflow the second method referred to comes into play. The nerve currents are forced to traverse ganglia and pass through the fine fibrillæ of the cells, which, like fine wires in the electric circuit, check the current, only permitting a portion of it to pass, while the remainder outflows into the ganglion as heat, or is converted into some more special mode of energy.

But this alone would not answer the purpose. In all high animal organisms it is necessary that the inflowing energy should be under special control. Some power of discrimination must exist, or must arise through the action of natural selection, to decide which currents of sensation shall pass onward to the muscles, and which shall be partly or completely checked. Only in this way could the nerve currents be prevented from calling up general and indefinite muscular responses, instead of the particular and well adapted responses necessary to yield the motions demanded by the best good of the economy. This is the third element in nerve evolution, and needs now to be considered.

It is well known that the nerve fiber is a very imperfect conducting material as compared with the metal of the electric circuit. How it conducts is an unsettled question. Its current resembles that of electricity in being simply a motor influence, perhaps in both cases set free by chemical change at the starting point of the circuit. Whether it resembles electricity in being a sort of radiant vibration through solid matter cannot be told. All we know is that its onward movement is excessively slow as

compared with electricity, and that the peculiar conditions of the instigating influence persist in the current. Yet though the nerve current moves slowly there is no indication that it meets any check in the conducting fiber or in the organ of sense reception. Probably every motor influence that can make its way through the outer surface to the nerve endings, of sufficient vigor to induce chemical action in or otherwise affect these endings, produces a nerve current without reference to its character. And every such current received by the nerves is transmitted and apparently even strengthened as it flows inward.

How is it, then, that some such currents pass directly onward to the muscles, while others are checked and disappear as current influences? There is strong indication that the ganglia perform this duty. The diminution of the diameter of the fiber in the nerve cell is a precise equivalent of the method adopted to produce the same effect upon the electric current. But the point here to consider is that of the evident discrimination displayed. In the sympathetic nerve system there is no evidence of such discrimination. There is a checking influence exerted, but it acts upon all currents alike. Each fiber probably passes through a chain of ganglia, each of which lowers the intensity of the current until it is finally unable to force its way further. Thus the distance to which a sympathetic current will flow depends upon its original strength. When, for instance, in the process of digestion the sympathetic nerve extremities are excited by the contact of food, certain muscles are affected, and produce the peristaltic movement of the intestine. If the contact influence is slight, this movement will be slight and local. If contact be vigorous the effect will grow more energetic and extend further, while a wider range of glands will be excited to action. If the contact influence be abnormally vigorous the effect will pass onward from the sympathetic to the spinal nerves, and the cerebrum be notified of the abnormal condition, while its motor lines of connection with the sympathetic nerves will be called into activity. We have every reason to believe that it is the ganglion not the fiber that thus diminishes the energy of the current. And the distance to which this current can travel depends on its vigor and the number of ganglia through which it is able to force its way.

The same is the case with the cerebro-spinal nerve system. Nerve impulses of a character that is usually checked may force

their way inward if exceptionally vigorous, and act upon the muscles. And significantly, in such cases, the motion produced is not special and definite but vague and general. The impulse, when it has forced a passage through the ganglia, does not select one motor channel in preference to others, but makes its way over the most conductive portion of the general motor system and calls many widely separated muscles into action. In this we have an indication of the original action of the nervous system, such as existed before specialization began and such as yet seems to exist in the sympathetic system.

The action of the ganglia, then, appears to be at once repressive and discriminative. Certain motor influences seem more capable of forcing a passage through the ganglionic resistance than others. The principle here involved seems to be that every motor influence of a new or unusual character is resisted, and ready passage is only allowed to motor influences to which the fibrillæ have become adapted. And here natural selection has come actively into play. Let us suppose the animals of a certain species to be subject to a definite series of motor impressions, each of which makes it way through the gangliar obstruction and tends to flow out generally to the muscular organs. Yet being insufficient in quantity to occupy every nerve, it will follow the largest, or those over which it finds the most open channel. Thus while the responsive movement might be somewhat general, certain muscles would obtain a surplus of the current and respond more vigorously than the others. In such a case natural selection must rapidly operate. The movements of some individuals would prove protective. Others would perish. And on the principle that the current of energy finds easiest way over the channel which it has already traversed, this particular motor influence would pursue its old channel in preference and be resisted by the other nerves. In like manner others of the sensory impressions might gain other favorite channels, and every sensation in time produce a particular action, adapted to the highest good of the animal.

But if the nerve fibers are only readily conductive to familiar motor influences, and if the gangliar cells resist all unusual sensory currents, another element comes into the situation. It is not only a question of the selection by the sensory currents of certain motor nerves in preference to others, but also of making

their way at all through the ganglia. A new sensory current may in some animals pass onward and produce motion. In others it may fail to reach the muscles. Natural selection would act here also, and might preserve the individuals which failed to respond to this sensation. Thus in a single animal some sensations will come to produce a certain motor response, other sensations another response, and still other sensations no response, and only the individual which is affected in just this manner can survive, since any other series of movements or non-movements would cease to be protective. Such an animal would be a correctly adapted reflex organism. No conscious or psychic powers would be necessary for its preservation.

The repression of the sensory current by the ganglia is probably a developmental characteristic of animal life. It only became necessary when sensation became active and abundant motor energy penetrated the body. It was absolutely necessary for the good of the economy that every sensation should not produce a motion, and the original nerve cells developed into ganglia, partly through this need of repression. These checked the great mass of the motor impulses, only permitting familiar ones to follow their ordinary channels. Yet such repression was not an intelligent one. It was largely governed, in fact, by the comparative vigor of the current. The principle seems to be that every sensory current, if sufficiently vigorous, may make its way through the gangliar resistance and affect the muscles. But currents of a special kind, which have already established a familiar channel, need less vigor to make their way through the ganglia, though even these are checked if very feeble. Finally special currents which have been repeated a great number of times may make their way onward even if very feeble. And in every case an abnormally strong current, even if it be of a kind that has established a familiar channel, will force itself to some extent upon other nerves and produce general and indefinite motions. This is the material out of which natural selection chooses its new adaptations. Finally a nervous organism thus specially adapted to surrounding conditions may be hereditarily transmitted, and a special series of reflex actions or resistances become inherent in the species.

The next question to be considered is, that of the disposition of this repressed current energy. So far, in accordance with the

electric analogy, we have considered it as transformed into heat. Such is what must become of it in a purely reflex organism, whose whole duty is to let certain currents pass and to repress others. But only in general cases does the repressed electric current become heat. In particular cases it becomes magnetism, mass motion and other forms of energy. Such seems to be also the case with the sensory current. As the checked electric current may be so employed as to produce a permanent condition or modification in certain matter, so is the checked sensory current. Memory results. That is to say that some substance contiguous to, or forming part of, the ganglion becomes permanently modified by the checked current of energy and assumes a condition which is persistent. And the change thus produced is not identical in character for every condition of energy, but varies with every variation in the producing cause. Thus the special character of the sensation is indicated in the particular effect it has exerted on the modified substance.

Such seems to be the character of memory. It is a condition produced by a motor influence. But motion can act only upon substance. And wherever it yields a localized, permanent, inherent effect this effect can only be an organizing one, exerted upon some substance. No motor effect can persist unchanged in any substance except it take part in the organization of that substance and produce in it some permanent modification. And it is quite within the limits of possibility that such a new condition may react on the current-bearing fibers and reproduce motor energy in the latter. Such seems to be the characteristic of memory. It is not necessarily conscious. Memory, as a rule, persists outside the range of consciousness. But it is necessarily a definite and permanent condition in something, and the word *something* necessarily signifies *some substance*.

Thus the current of motor energy which forces its way from external nature into the body, and is borne inward over the channel of the nerves, yields two opposite effects. When it reaches the muscles its effect is disorganizing. It causes chemical disintegration with an outflow of general energy, in which that of the nerves is merged and lost. When it is checked in the ganglion it seems to exert an organizing effect, perhaps attended by chemical integration, or the formation of chemical molecules of a high order. As to this, of course, nothing can be said, but that it

yields a specialized effect for every special mode of sensation, and that this effect is permanent, the phenomena of memory prove. And no such effect can be produced by motion upon substance except it take part in the organization of that substance. Motion otherwise related to substance must flow out and disappear. Only the motion to which formation is due persists in any molecule or organized mass.

Possibly every ganglion has its memory. But it is much more probable that in the continued development of the nervous system, as superior or more centralized ganglia originated, the function of the lower ganglia became simply distributive, and they ceased to exert a repressive influence upon the current. Thus in a vertebrated animal, for instance, it is not improbable that the discriminative power of a spinal ganglion lies between its sending a sensory current directly to some muscle or sending it upward towards the cerebrum. It is a question of short circuiting the current, or of transmitting it to the central office. To the extent that reflex action has been established in the Vertebrata this short circuiting is the method pursued. It is the normal method in the sympathetic nerves, whose current makes its way to more and more central ganglia only as it grows in strength or becomes unusual in character. It is the method in many of the cerebro-spinal nerves for actions that have become habitual, like those of walking, for instance. Only when the regularity of step is in some way interfered with does the sensory current force its way to the cerebrum and arouse consciousness.

In nerve development, then, an early stage is the appearance of the ganglion with its discriminative and repressive powers and its memory record. A later stage is the appearance of several ganglia, one more central to the whole nervous system than the others. In this case, as we may conceive, the function of the inferior ganglia becomes confined to discrimination between sending a sensory current directly to the muscles or onward to the central ganglion. The power of final decision and repression of the current may be confined to the latter, and it may become the sole seat of memory. This centralization makes continuous progress through the lower life forms. It is clearly indicated in the insects, yet here it is doubtful if it has gained ascendency over reflex action, to which the great mass of insect motions seem due.

For this reason the loss of the head section in certain insects seems very slightly to decrease their motor powers.

As we ascend through the Vertebrata, however, nervous centralization rapidly proceeds. The cephalic ganglion, or mass of cephalic ganglia, grows more and more predominant over the inferior ganglia, and the sensory currents are diverted more and more fully towards this central region. Throughout the whole upward range the phenomena of nerve development indicates that reflex action grows less and less, and conscious action more and more declared. In certain fossil vertebrates of huge form, the mass of the inferior surpasses that of the cephalic ganglia, indicating a great degree of reflex action. Throughout the fossil series cephalization seems to steadily increase, indicating a growing superiority of conscious over reflex action.

Yet this change was only made by slow stages, and an interesting intermediate stage seems to have intervened between reflex and habitually intelligent action. This is the stage of instinct, in which reflex action and consciousness seem to be combined. In this stage the sensory currents, on reaching the inferior ganglia, seem to partly follow an habitual channel to the muscles, partly to pursue a channel to the central ganglion, where they awaken consciousness. It is a usual stage in the change from fully conscious to reflex action. In every such case intelligence may exercise some controlling function, with a possible modification of the reflex action. Finally, in the highest animals, the upward channel has become the habitual one for all but the most deep-seated or incessantly continued sensory impressions, and intelligent has grown more and more dominant over reflex and instinctive action, until in man it has become the controlling agent in the great sum of actions.

There is a principle, already stated, to which this increasing cephalization seems due. The nervous system is not readily conductive to unusual sensory impressions. It has become so to ordinary impressions, each of which has established for itself a habitual channel. But every unusual impression is checked at the ganglion, and can only make its way onward if of considerable strength, and then over the general motor system, not over any particular motor nerves. If this sensation becomes an ordinary one, natural selection decides whether it shall gain some settled channel of outflow to the muscles, or shall be finally

checked at the ganglion. And another result of great importance is that every such unusual impression, thus partly or wholly checked in its course, produces the effect of memory at the ganglion. Thus a record is laid up in the memory of every unusual impression, which is vivid at first but grows less and less so with every repetition of this impression. Finally, when a particular sensation grows habitual it may cease to affect the memory record. It has already made a deep impression there, and it subsequently is received with less and less consciousness of its existence. If it passes on to the muscles it may do so utterly without affecting consciousness, or become completely reflex.

As centralization proceeds it seems probable that all such unusual impressions are directly transmitted from the inferior to the central ganglia. In this direction there appears to be the freest channel of conduction for sensory currents. Usual impressions may have opened direct lines to the muscles, but unusual ones pursue a more open and general channel leading towards the central organ, in which the final duty of discrimination is exercised. And as a consequence, in the higher vertebrates the main center of reflex action seems to have become the ganglia at the base of the brain. In the insects the ganglia of each section seem to exert an active reflex function. This has largely ceased to be the case with the spinal ganglia of man, whose main reflex center is the cerebellum and the contiguous ganglia.

In all the higher Vertebrata a nervous organ has been developed which does not seem to exist in the invertebrate animal world. This is the cerebrum. It is a special gangliar organ devoted solely to the duty of memorizing, and one in which consciousness has become centralized. In the ant, the most intelligent of invertebrate animals, there is no apparent differentiation in the head ganglion. It is a single organ, centering in itself duties of reflex and instinctive action, and of memorizing. In the highest animals these duties have become separated. The inferior brain ganglia apparently possess the function solely of reflex action, if we may view as a constituent part of this function the diversion of unusual impressions upward to the cerebrum. That is to say, they have lost all power of checking the flow of nerve energy. Memorizing and psychical action seem confined to the cerebrum. And intermediately sensations of increasing frequency grow partly reflex and partly affect the cerebrum without calling

out any conflicting orders from the intelligence. Such cases are those named instinctive. Their steady course is towards the fully reflex condition. The memory record of them may become so complete, through frequent repetition, that finally they fail to produce any effect, or to arouse consciousness. Cases of this kind are by no means confined to the lower animals, but may be found in some of the most difficult operations of the human sensory organism. In the oft-quoted case of the skillful pianist, for instance, as the fingers become habituated to a certain series of movements, attention may be more and more withdrawn from the action until it reaches the instinctive stage, a vague consciousness of the movement perhaps persisting but no intelligent oversight being necessary. Only when some change in the succession of sound is produced, however caused, does consciousness at once become again active. The element of the unusual has been introduced and the sensory current immediately makes its way in its full force to the cerebrum, arousing the powers of the dormant attention.

The cerebral organ of man does not seem to be a constituent part of the general nervous system. Its sole duties are connected with the evolution of the mind. If it be completely removed animal life does not necessarily cease. But its removal shows to what an extent the life action is reflex. The lower vertebrates may continue to live for a long time without the cerebrum, and perform most of the essential duties of life. Yet every trace of memory goes with its removal, and they act only as automata. In insects the life functions are still more fully performed, showing here an inferior dominance of the mental powers. Possibly but for the shock to the organic system by its removal, its function of memorizing might be in part relegated to the cerebellum, and the embryo state of a new mental development be produced.

According to the hypothesis of Professor Christiani,[1] devised from experiments with disbrained rabbits, the cerebrum forms a kind of secondary circuit, into which a large portion of the energies enter and are stored up, while the basal ganglia form a primary circuit, which transforms the energies into reflex motions. He found that with the removal of the cerebrum all energy was transferred into reflex motion, so that disbrained and decapitated

[1] Journal of Physiological Society, June 20, 1884.

animals displayed much stronger reflex action than normal ones. In normal animals much of this distributed energy ascends to the cerebrum, where it becomes converted into consciousness and ideas.

According to Luys the optic thalami are intermediary sensory organs interposed between the purely reflex phenomena of the spinal chord and the activities of psychical life. So the corpora striata are seated at the summit of the motor nerve system. Thus it becomes a question of gangliar discrimination whether a sensory impression, on reaching the optic thalamus, shall be at once transferred to the corpus striatum and thence through the motor nerves to the muscles, or shall proceed to the cerebrum and motor impulses descend to the corpus striatum through that channel. In this latter case we venture to hypothesize that all reflex action vanishes, and that all sensory impressions that ascend to the cerebrum end there. If subsequent action take place it must be in response to new initial energy emanating from the mind and wholly governed by the intelligence.

These considerations lead to the idea that the cerebral organ may be in an anatomical sense a secondary circuit. That is, that the nerve fibers of the body may not be in direct communication with the cerebrum. It may be possible that the sensory fibers that enter the basal ganglia are continuous through the nerve cells only with the outgoing motor fibers, and that the cerebral fibers which enter these ganglia form a circuit of their own through fibrillæ of the same cells. In such a case the influence of the primary on the secondary nerve circuit could be inductive only, and we would have a mechanism similar to that of an electric inductive system. This idea of course can have no warrant in experiment, but it is offered as a suggestion that the many close analogies between the nervous and the electric current may be completed by a condition like that of induction, which plays so prominent and important a part in electric phenomena. The sheathing of the nerve fibers by the medulla seems to be an insulating apparatus. Their naked condition in the ganglia must favor induction, and renders it possible both that the transfer of a sensory current to two or more outgoing nerves may be through induction between the fibrillæ, and that its transfer to a cerebral nerve may be through induction. It is not impossible, indeed, that the check to the sensory current in a ganglion may arise

through inductive transfer of its energy to a series of fibrillæ which are short circuited in the ganglion and make no connection either with ingoing or outgoing nerves.

This hypothesis of an analogy between the action of the nervous current and that of electric induction is at least of some interest, and may be further pursued. We have argued that to this checked current the phenomena of memory are due. If it arise from the transfer by induction of the sensory current to a series of fibrillæ, forming a secondary short circuit through the ganglion (continuous, of course, as all inductive currents must be), then we would have here a new apparatus for the operation of organic forces, and one leading directly to the development of a separate cerebral organ. For, as above considered, in the development of the nervous system the check to the sensory current in the ganglia became a duty of growing importance, and the volume of checked energy steadily increased with the growth of nervous susceptibility. If, then, this check took place through the action of a separate inductive circuit, this apparatus must have developed with its increase of duty. At first confined to the same cells which transmitted the reflex current, the inductive fibrillæ may have grown in length and number, and in time gained cells of their own, with connecting fibers. Through these cells the checked current would produce its final effect, whether of memory conditions or otherwise. By a continuance of such a process the cells of the inductive circuit might become separated entirely from those of the primary circuit, forming first a cerebral layer upon the central reflex ganglion, and finally a completely separate ganglion connected only by nerve fibers with the system of reflex ganglia.

Such is conceivably the mode of origin of the cerebrum, and the character of its nerve relations with the nerves of the reflex system. As intelligence grew and the great mass of sensations were transmitted to the cerebral circuit, this organ would necessarily greatly develop, until from a series of secondary fibrillæ short circuited through one or a few cells, it became the great cerebral organ of man, with its highly important function of the evolution of the mind.

We may very briefly recapitulate the conclusions to which the foregoing arguments have led. The motor energy of the external world makes its way in various forms or phases into the ani-

mal body by the channel of the sense organs and the sensory nerves. Reaching a ganglion it is received by the cells, perhaps by many of them through the division of the fiber into its constituent fibrillæ. It either continues over its original fibrillæ to the motor nerves which issue from these cells, or is transferred, partly or wholly, to other fibrillæ by induction. In such a case it may be carried to other motor nerves, or enter upon a short local circuit and yield the local effect called memory; that is, a peculiar organizing effect in which is represented its peculiar character. Or this secondary circuit may convey it to a higher or more central ganglion, in which the same modes of distribution may be exercised. In highly developed animals it may pass through several such intermediate ganglia, and be finally, in part or wholly, transferred by induction to the cerebral ganglion. In this it exerts but one action, that whose effects we call memory, a permanent transformation produced in some organizable substance. This effect is the germ of all mental development.

(To be continued.)

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AFFINITIES OF ANNELIDS TO VERTEBRATES.

BY E. A. ANDREWS.

AS a group the annelids exhibit in a prominent degree both bilateral symmetry and segmentation. The former is well expressed in the adult, in the early larval stages and even at the period of closure of the blastopore, when the radial symmetry of the gastrula becomes replaced by bilateral symmetry.

Segmentation, so pronounced in the adult, is not found in what we may regard as the most primitive larval form, the Trochophora of such forms as Serpula, or as more perfectly expressed in some species of Polygordius.

These two fundamental characters, bilateral symmetry and segmentation, naturally lead to a comparison of this group with the other segmented Bilateralia, of which the Vertebrata especially have attracted attention in seeking for the allies of the annelids; or rather in the attempt to derive the vertebrates from invertebrate groups, the annelids have furnished important aid.

Of those who have paid especial attention to the subject and who maintain a close relationship between the annelids and vertebrates, may be mentioned Semper, Dohrn and Hatschek. Semper seems to have advanced the most evidence in support of his

views, working mainly from the standpoint of comparative anatomy, and drawing little or no material from the larval stages of annelids. His views may be briefly (and thus necessarily imperfectly) stated as follows: Regarding the distinction of ventral and dorsal surfaces as of little morphological importance, we may make a direct comparison of annelid and vertebrate by supposing the mouth of the annelid to be a new formation, and that a mouth once existed upon the hæmal (dorsal) side of the annelid which was homologous with the mouth of the vertebrate (Figs. 1, 2).

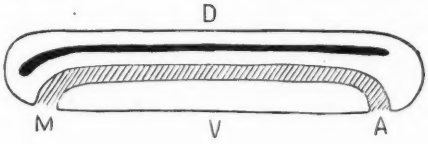

FIG. 1.—Diagram of a vertebrate according to Semper's view, showing relative positions of nerve-cord, digestive tract, mouth (*M*) and anus (*A*); *D*, dorsal, *V*, ventral surface.

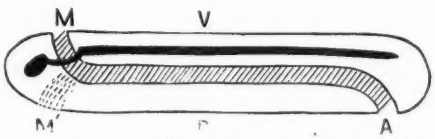

FIG. 2.—Diagram of an annelid according to Semper. *M*, mouth; *A*, anus; *M'*, primitive mouth; *D*, dorsal, *V*, ventral surface.

He draws close comparison between the muscles, nervous structures and excretory organs of the two groups, basing his views largely upon the study of the urogenital organs in the lower vertebrates and the process of asexual reproduction in certain oligochætous annelids.

In these forms new individuals are formed in chains by the appearance of budding zones across the body of the asexual parent, each of which zones gives rise anteriorly to the trunk of one zoöid, and posteriorly to the head of the next following zoöid, so that two adjacent zones form a new individual between them, and parts of the new individual in front of the anterior zone and behind the posterior zone. As these individuals eventually break loose as forms like the parent it is necessary that each acquire a new mouth and œsophagus, supra-œsophageal ganglion and muscles. In the formation of these structures from the preëxisting tissue and from more indifferent embryonic cells,

Semper finds an identity in fundamental plan between annelid and vertebrate. Though establishing so many homologies between the two groups, he does not derive one from the other, but inclines to the view that both are descendants of a segmented planarian-like ancestral form which on the one hand gave rise to the vertebrate group by the enlargement of its anterior ganglion to form a brain and by the union of its separate nerve cords along the dorsal side to form the spinal cord, while on the other hand the annelid was formed by the acquirement of a new mouth piercing the nerve cord or passing between the still separate nerve cords and by the closure of the primitive mouth.

Dohrn's views on the affinities of the annelids to the vertebrates are very interesting, if perhaps of less importance as being purely hypothetical.

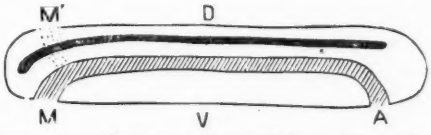

FIG. 3.—Diagram of vertebrate according to Dohrn. *M*, mouth; *A*, anus; *M'*, primitive mouth; *D*, dorsal, *V*, ventral surface.

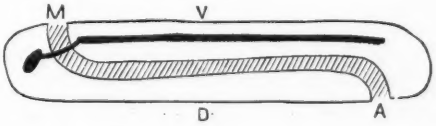

FIG. 4.—Diagram of an annelid according to Dohrn. *M*, mouth; *A*, anus; *D*, dorsal, *V*, ventral surface.

Homologizing the dorsal surface of one group with the ventral of the other, he finds the necessity of supposing a new mouth to have existed in one group, and unlike Semper regards the vertebrate as the form in which this new structure was formed (Figs. 3, 4). Seeking a trace of the primitive mouth of the vertebrate homologous with the mouth of the annelid, which is on the neural side, he finally concluded that the *fossa rhomboidalis* of the vertebrate represented the area of the nervous system formerly pierced by the œsophagus on its way to a neural mouth, there being thus a circum-œsophageal ring formed homologous with that of the annelid. The present mouth of the vertebrate was thus a new formation having no homologue among the annelids.

The genetic relationship of the two groups he conceives to have been that of diverging branches from a common ancestor. This hypothetical ancestral form was a segmented annelid-like creature with a chorda, gills on all the segments, supported by a cartilaginous rod on the side of each segment, with a neural mouth like that of an annelid and with a pair of segmental organs in each segment opening to the exterior and also internally into the digestive tract. From this ancestor the vertebrates arise by an interesting series of modifications in structure due to "change of function" of the primitive structures; some of the segmental organs gave rise to the mouth and branchial clefts, while others formed the genital and urinary ducts and even the anus; the branchiæ were variously modified to form the branchiæ of the vertebrate, its fins and limbs and perhaps the external genital organs; the cartilaginous supporting rods gave rise to the ribs, skeleton of the limbs and part of the skull.

This hypothetical ancestor was more highly specialized than the present annelids, which have since degenerated, perhaps (he thinks), owing to the sharp competition between the more annelid-like and the more vertebrate-like forms of the common ancestral group. The whole tenor of Dohrn's work inclines to the conclusion that annelids, like ascidians, etc., are degenerate vertebrates.

However satisfactory in explaining an origin of the vertebrates from an hypothetical ancestor this hypothesis may or may not be, it apparently is unsatisfactory in so far as it concerns the annelids.

Much of the evidence in support of Hatschek's views is derived from a consideration of the development of annelids, both of Polychætæ and of Oligochætæ.

His comparison of the two groups, annelids and vertebrates, is essentially that of Dohrn's (Figs. 3, 4) except that he does not place the point where the primitive œsophagus pierced the nervous system at the *fossa rhomboidalis* but at the *hypophysis cerebri*, a position more comparable to the present position of the mouth among the annelids, as it is farther forward, in the unsegmented portion of the head. He reduces the excretory organs in both groups to a common type represented by a transient stage in the larva of certain annelids when the branched excretory tube in the head of a Trochophora larva sends back a branch into the trunk, this longitudinal tube gives rise to the segmental tube in each

segment of the trunk, and thus a stage is present where the segmental organs are connected by a common longitudinal duct. In the annelid this connection is lost (though perhaps retained in a few), while each segmental organ acquires an external opening. In the vertebrate the primitive connection persists, and no external opening is developed for each segmental organ.

The conclusion reached by Hatschek is that annelids and vertebrates have had a common segmented ancestor, which did not differ much from such a simple annelid as Polygordius.

The three authorities now mentioned represent sufficiently the views of those finding more or less close relationship between the vertebrates and the annelids; there are others who regard this relationship as very remote, if existing at all, either placing other invertebrate forms nearer the vertebrates or separating this group from the annelids, from consideration simply of the fundamental differences of the two groups. Among the latter may be reckoned Mr. Adam Sedgwick, whose ingenious hypothesis includes the question of the relationship of these two groups, though advanced with the much wider object of accounting for segmentation and the origin of the Triploblastica from cœlenterate-like forms. Founded upon the behavior of the blastopore and upon the structure of the cœlenterates, the hypothesis calls for a cœlenterate-like ancestor with mouth and anus part of one common opening to the digestive tract which bore diverticula on each side, indicating a segmentation, and communicating with each other as well as with the exterior; the nervous system formed a broad ring around the mouth-anus (Fig. 5). From this common hypothetical ancestor the annelids were derived by the separation of the mouth and anus, by the partial fusion of the two sides of the nerve-ring along the median line between the mouth and the anus, with atrophy of the part behind the latter opening

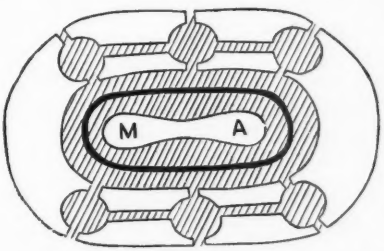

FIG. 5.— Diagram of Sedgwick's hypothetical ancestral form of vertebrates and annelids, showing mouth (*M*) and anus (*A*) as part of one common opening; digestive tract and pouches and nerve-ring.

and by loss of the connections of the lateral pouches with one another and with the digestive tract, thus forming the segmented body-cavity and the segmental organs. The vertebrate was formed by a more complete union of the lateral parts of the nerve-ring between the separated mouth and anus, together with disappearance of its two ends, by the persistence of some anterior pouches to form branchial clefts, by the loss of external openings for others which remained connected with one another and with the digestive tract at one point to form part of the body-cavity and the urogenital ducts, and finally by the retention of only the outer openings of the last pair of pouches which form part of the body-cavity and the abdominal pores. Mouth and anus are thus homologous in the two groups, and primitively neural in position; the mouth in the vertebrate acquired its present ventral or hæmal position by advancing around the anterior end of the body.

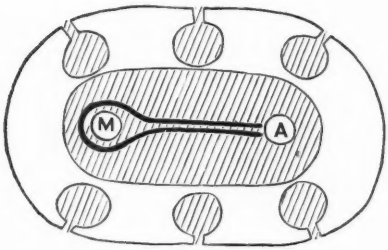

Fig. 6.

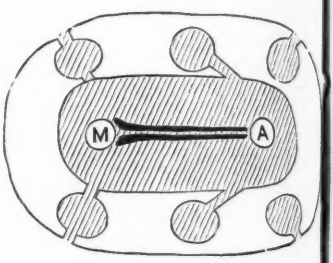

Fig. 7.

FIG. 6.—Diagram of an annelid according to Sedgwick. *M*, mouth; *A*, anus.
FIG. 7.—Diagram of a vertebrate according to Sedgwick. *M*, mouth; *A*, anus, with spinal cord between.

A still more remote separation of the annelids from the vertebrates is required by the comparisons instituted by Goette from a study chiefly of the development of planarians and annelids; the fundamental ground-plan of the two groups is, he thinks, essentially different, as shown by the entirely diverse ways in which the gastrula is modified in the two to form the adult. In the annelid the blastopore closes along a line which corresponds to the longitudinal axis of the adult, the mouth being formed from its anterior part and the anus near its posterior end; the nervous cord is formed along this line of union of the lips of the blastopore. Thus the ventral surface of the adult represents the

blastopore area of the gastrula—the area opposite the upper end (summit) of the gastrula and in a plane at right angles to the chief axis of the gastrula, and along this ventral surface or blastopore area the nerve-cord is developed. In the vertebrate, on the contrary, the blastopore closes in a small area representing the posterior end of the adult and entirely behind the nervous system, corresponding in part to the anus in position. The blastopore area being thus the hind end of the adult, the ventral surface of the adult is formed from one side of the gastrula while the nerve-cord develops upon the opposite *side* of the gastrula in a position more nearly parallel with the chief axis of the gastrula.

In an annelid, then, the ventral surface with the nerve-cord correspond to the original lower or blastopore surface of the gastrula, and the mouth represents the anterior end of the blastopore. In a vertebrate the ventral surface corresponds to a side of the gastrula, while the surface homologous to the annelid's ventral surface is found represented in the vertebrate merely by the anal region, this being the blastopore area of the gastrula; the mouth in the vertebrate is a new structure formed remote from the area of the blastopore, and not at all comparable to the annelid mouth except in function.

Figs. 8 and 9, copied from Goette's work, will serve to illustrate this comparison of the two groups.

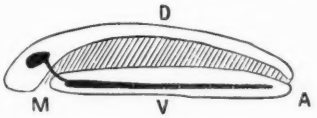

Fig. 8.

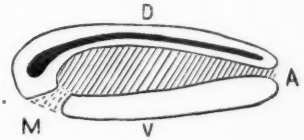

Fig. 9.

FIG. 8.—Diagram of annelid according to Goette. *D*, dorsal, *V*, ventral surface; *M*, mouth; *A*, anus. FIG. 9.—Diagram of vertebrate according to Goette. *D*, dorsal, *V*, ventral surface; *M*, mouth; *A*, anus.

The preceding statements may serve to indicate the chief views upon the subject, showing how much difference prevails in the hypotheses advanced to solve the important morphological problem of the exact affinities of the annelids and vertebrates, and at the same time indicating, perhaps, a tendency among those who have recently investigated the embryology of the annelids to

separate this group much farther from the vertebrates than was customary when most of the evidence was derived from the comparative anatomy of the adults.

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THE USE OF COPPER BY THE DELAWARE INDIANS.

BY CHARLES C. ABBOTT, M.D.

IN the *American Antiquarian* of November, 1884, Mr. Edwin A. Barber, speaking of the Indians of Pennsylvania, remarks:

"The copper age is represented by a few specimens of copper implements which have been discovered in different localities; but these could scarcely have been produced by the Lenni Lenape tribe. They were doubtless obtained from the ancient miners of Lake Superior, or at least were the remains of the industry of the mound-building race, which had found their way into Pennsylvania."

Referring in 1881 to the use of copper, by the New Jersey tribes, I also expressed the opinion that it was "not improbable that all the copper articles found along the Atlantic coast, were brought from western localities."[1] A careful re-survey of many localities where ordinary Indian stone implements occur in abundance; and correspondence with collectors in various portions of New Jersey and Eastern Pennsylvania now convince me that the use of copper, as implements and ornaments, was much more common than I supposed, and that among our Delaware Indians were many coppersmiths.

In the fifteenth annual report of the Peabody Museum of American Archæology, Professor Putnam describes two examples of copper spears, of which he says, while "these spear-heads closely resemble one in the State Historical Society of Wisconsin," yet they differ in the important feature of having smooth edges, while the Wisconsin specimen has a serrated point. These were both made "from a mass of native copper, hammered into shape, as shown by several small laminations which can be distinctly traced."

From the same locality a third example has been found (Fig. 1)

[1] Primitive Industry, p. 413. Salem, Mass., 1881. Geo. A. Bates.

which does not differ in any important feature from the preceding except that it has a smoother surface, and appears to have been ground or polished, after being brought to its present shape, by hammering.

Associated with the three spears was a small celt differing in no respect from scores of such objects found in Pennsylvania and New Jersey. The illustration (Fig. 2) represents the specimen, of actual size, and needs no detailed description of the object. Suffice it to say that the evidence of its having been hammered into shape is as patent as in the examples of spear-heads described by Professor Putnam.

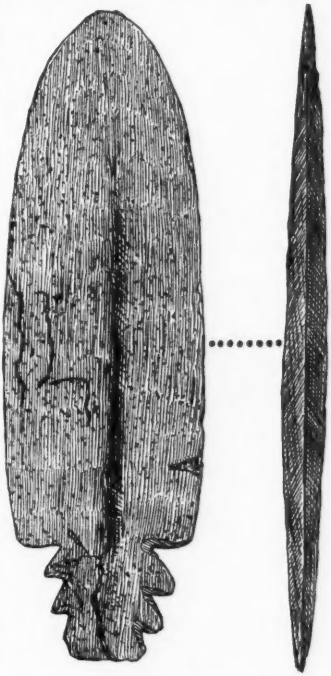

FIG. 1.—Copper spear from Trenton, New Jersey.

Recently I have had the opportunity of examining a large collection of Indian antiquities, made in the neighborhood of Reading, Penn., and about Bristol in the same State. In this collection are several copper objects, all of which are of patterns that have already been found and described from other Atlantic seaboard localities. They are of much interest, however, as showing that more of such objects were in use than has been supposed, and proportionately as the number found here increases, does the probability of their having been brought from a distance decrease; for there is found both in Eastern Pennsylvania and in New Jersey, a very considerable amount of native copper. Indeed one mass weighing over one hundred pounds has been found in Somerset county, New Jersey.

Besides celts and spears there have been found many ornaments of copper, which clearly showed that they were made by the same hammering process; and the character of the metal showed, in many cases, that it was identical with the nodules of

impure native copper found in this region, and not, therefore, metal derived from the Lake Superior region.

When the Delaware and Raritan canal was dug, in 1832, there were found many skeletons of Indians during the course of the excavations. About the wrist bones of many were narrow bands of hammered copper, and some large crescent-shaped ornaments were also found. In one instance a grave was opened which contained a nodule of native copper weighing thirteen ounces.

This information was derived from a gentleman who saw many of the objects mentioned, and who carefully examined the skeletons and grave contents as they were brought to light.

Although the specimens have long since been lost, their identification as copper objects of Indian manufacture was carefully

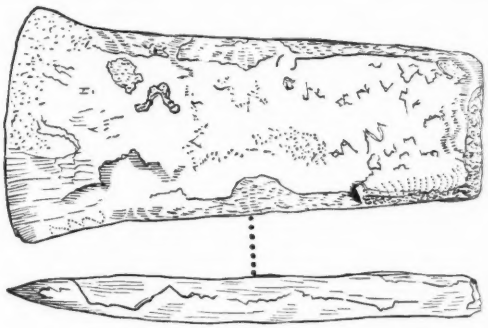

FIG. 2.—Copper celt from Trenton, New Jersey.

made; and as this is information not readily obtained and has a distinct bearing upon the question of the use of copper among our Indians, it is worthy of being put upon record.

In the many small collections of Indian relics made in different localities that I have examined, I find that one or more celts, spears, arrow-points, bracelets, rude beads or fragments of sheet copper are sure to be found, and a tabulation of these objects, and the information derived from correspondence, gives the following results:

Celts, 11; spears, 5; arrow-points, 8; bracelets, 13; beads, 70; fragments of metal, 21; in all, 128 objects. When we consider how small a chance there is of such objects being found, and what a small proportion of such as are recovered come to the knowledge of archæologists, it is a most reasonable presump-

tion that the Indians had a more familiar knowledge of copper than merely as a material, ready-wrought, which they could only procure through barter with far distant tribes.

There is yet another feature which should be briefly dwelt upon. Among the fragments, so-called, of hammered copper, are several which have every appearance of being unfinished objects. One is, I think, intended for a finger ring, such as those from Ohio, described by Professor Putnam; and another strongly suggests those curious large ear-rings of which that author found so many specimens in recent mound explorations.

It would appear, then, from an examination of the copper objects found in Pennsylvania and New Jersey, that the weight of probability is strongly in favor of their home manufacture; and the similarity of the forms to those taken from areas where mounds occur is another fact in favor of the rapidly growing impression that the builders of these earth-works and the Indians of the coast were essentially one people.

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— Just and courageous criticism is necessary to the maintenance of excellence in all departments of human activity. An indisposition to submit to it on the one hand and a fear to exercise it on the other, are sure indications of the weakness or decay of an important element of character. Even unfair criticism, bad though it be, is better than none, as it gives indication of life, and is sure to be itself corrected in the end. The attempt to suppress criticism is an unwise proceeding, which will react on its authors. It is better to "make a clean breast," if need be; and if facts do not require it, this also can be made plain. The force of just criticism is not weakened by suppression, but is rather increased in energy; while the expression of it draws the fire and silences the gun of the critic. It is a great error to confound criticism on behalf of the truth with personal hostility, yet it is an error by no means rare. To occupy a perfectly judicial attitude towards our own productions requires some moral elevation, which all men do not attain to. Unjust criticism, indeed, is ground for complaint against the critic.

Hence if the critic deserve the name, justice only will be his infallible guide.

People of sensibility and refinement shrink from controversy; and the enervated and dishonest endeavor to avoid it altogether. But it cannot be escaped without a total withdrawal from the field of action, or an attainment of perfection such as rarely falls to human lot. In the scientific world all the aspects of this question come before us from time to time. We meet the sometimes brutal vigor of German truth-telling, contrasted with the dexterous fencing of French elegance and skill. We meet with inexcusable rashness or misrepresentation on the one hand, and with subservient cowardice or fulsome adulation on the other. In our own country science is none too strong in criticism. With here and there healthy exceptions we have a good deal of paralysis in this direction. In a few quarters the indisposition to accept fair criticism is marked. But there is enough virility in our scientific community to accustom such weak brethren to this one of the phases of "the struggle for existence," by administering more criticism in judicious quantities so long as their cases may seem to require it.

—— If the bureaus of the Government would send their return receipt with or in the publications they issue, every one concerned would be greatly accommodated. The return receipts would then be promptly returned, whereas as now sent at another time, it requires time and trouble to identify the package referred to, which sometime results in a failure to return the receipt as desired.

——We are sorry to see our cotemporary *Mind in Nature* admitting to its columns articles like that of Professor Piper on evolution. If the author had spent his time in studying field mice, or garter-snakes, or trout, or minnows, he would have learned to know something of the subject on which he writes so fluently.

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RECENT LITERATURE.

DE CANDOLLE'S ORIGIN OF CULTIVATED PLANTS.[1]—Two years ago the French edition of this book made its appearance, and was favorably received and noticed by the botanical world. It

[1] *International Scientific Series. Origin of Cultivated Plants.* By ALPHONSE DE CANDOLLE, foreign associate of the Academy of Sciences of the Institute of France, foreign member of the Royal Societies of London, Edinburgh and Dublin, of the Academies of St. Petersburg, Stockholm, Berlin, Munich, &c., &c. New York, D. Appleton & Co., 1, 3 and 5 Bond street. 1885, pp. x, 468.

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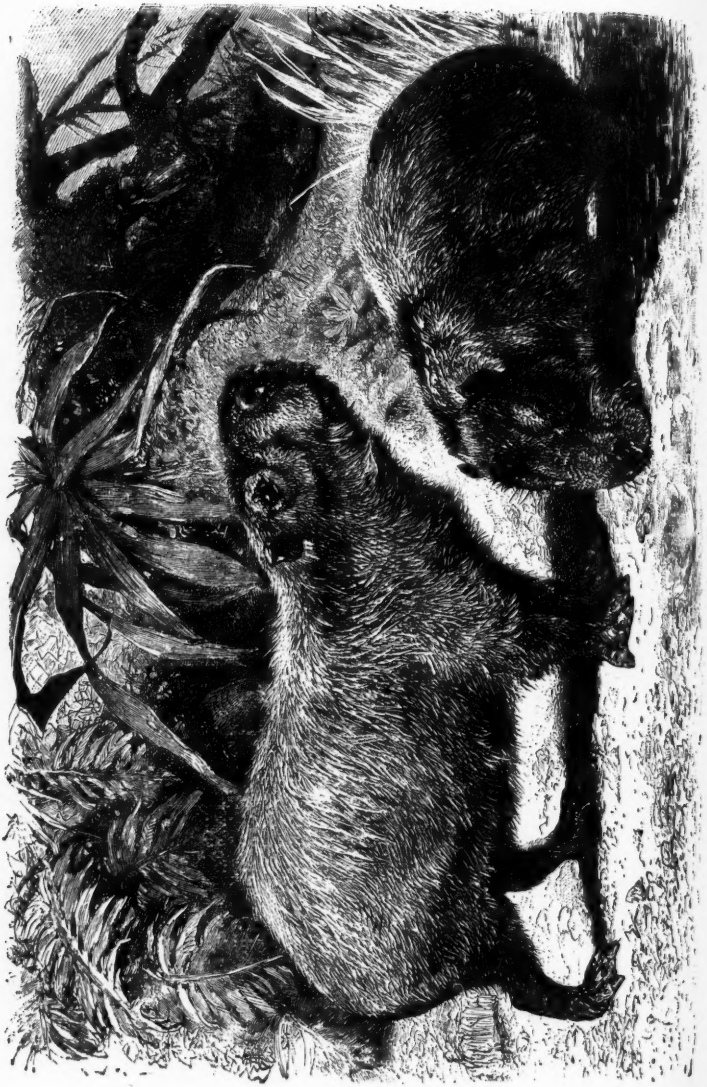
PLATE XXVII.



Capybara, from South America.

was made the text (to some extent) of instructive articles by Gray and Trumbull, which appeared in the *American Journal of Science* during the year 1883, some of the matter of which has been incorporated by the author in the English edition which has now made an appearance. This edition is, therefore, somewhat more than a mere translation, and partakes of the nature of a new edition.

The purpose of the book may be given in the following paragraph in the preface: "I have always aimed at discovering the condition and the habitat of each species before it was cultivated. It was needful to this end to distinguish from among innumerable varieties that which should be regarded as the most ancient and to find out from what quarter of the globe it came. The problem is more difficult than it appears at first sight. In the last century and up to the middle of the present, authors made little account of it, and the most able have contributed to the propagation of erroneous ideas. I believe three out of four of Linnæus' indications of the original home of cultivated plants are incomplete or incorrect."

The book is divided into three parts. In the first we have a general discussion of the epochs of cultivation and of the method of discovering the origin of cultivated species. In the second part plants are taken up systematically and discussed as to their origin. Thus we have first those plants which are cultivated for their subterranean parts, next those cultivated for their stems or leaves, then those cultivated for their flowers or the organs which envelop them, next those cultivated for their fruits, and lastly those for their seeds. In part third we have interesting summaries and conclusions, accompanied with various tables of species.

In all the author has examined 247 species, of which 199 originated in the old world, 45 in the new world, with three whose origin has not yet been determined. "A noteworthy fact is the absence, in some countries, of indigenous cultivated plants. * * * The United States, in spite of its vast territory which will soon support hundreds of millions of inhabitants, only yields as nutritious plants worth cultivating the Jerusalem artichoke and the gourds;" a statement which apparently overlooks our excellent grapes which are derived from several native species, our blackberries, raspberries and strawberries.

On page 460 we find the remark: "I have not observed the slightest indication of an adaptation to cold. When the cultivation of a species advances towards the north (maize, flax, tobacco, etc.), it is explained by the production of early varieties, which can ripen before the cold season, or by the custom of cultivating in the north in summer the species which in the south are sown in winter." To this we apprehend our horticulturists will not assent. It may be true in the three examples cited, as well as for many others annuals, but what shall we say for the varieties

of the peach, pear and apple, which vary so much in their hardiness? Every fruit grower in the Northern States knows well that certain varieties of these trees will endure the winter while others will not. This may not be due to any adaptation to cold, but it certainly does not admit of the simple explanation given by the learned author. There have certainly been variations in the hardiness of cultivated plants, and these variations have, by judicious selection, made it possible for us to extend very considerably the range of the species.—*Charles E. Bessey.*

OUR LIVING WORLD.—Under this title Mr. Selmar Hess, of New York, is publishing in forty-two quarto numbers a popular work on natural history, which will be welcomed by young people on account of the abundant and showy illustrations.

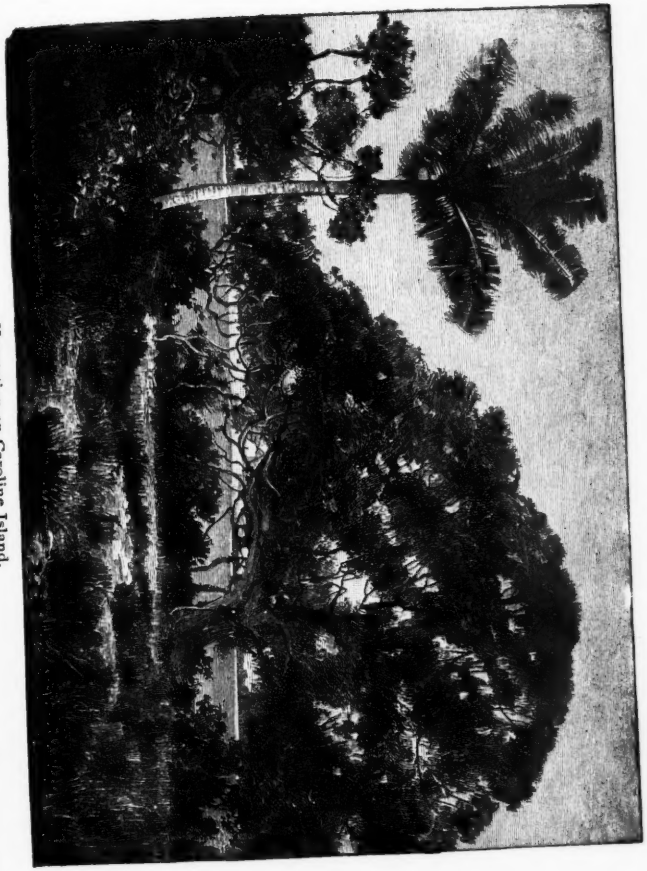
The text is based on Rev. J. G. Wood's, and is anecdotal rather than scientific; it has been adapted for American readers by Dr. J. B. Holder. The wood-cuts are those which have appeared in Wood's book, also in Brehm's Thierleben, while the colored plates are oleographs reproduced by Prang from the exquisite chromo-lithographs of the great work of Brehm.

As a picture book of the animal creation, particularly of the vertebrates, it will prove attractive. The accompanying illustration of that strange animal the Capybara, the "native hog" of South America, the largest of existing rodents, will give an idea of the kind of illustrations used in the numbers we have thus far received. While, then, not specially authoritative or American in its plan or authorship, we doubt not that it will be welcomed by many as a readable "natural history."

As respects the classification adopted, the arrangement should be such as is generally followed by modern zoölogists. To place the marsupials between the land Carnivora and the seals is a violation of the simplest principles of classification. The Insectivora and bats are placed too near the primates, although it should be said that the position of these groups is in dispute.

The work will be issued in forty-two parts of forty-eight pages at fifty cents a part; it will contain forty-two oleographs and eighty-four full-page wood engraving. The paper and press-work are excellent.

MEMOIRS OF THE NATIONAL ACADEMY OF SCIENCES.—The third volume of the National Academy appeared in 1884 from the Government printing office. It is a quarto volume of 262 pages, and contains four memoirs read before the academy in 1884, under the following titles: Report of the Eclipse expedition to Caroline island, May, 1883; Experimental determination of wave-lengths in the invisible prismatic spectrum, by Professor S. P. Langley; On the subsidence of particles in liquids, by Professor W. H. Brewer; On the formation of a deaf variety of the human



Vegetation on Caroline Island.

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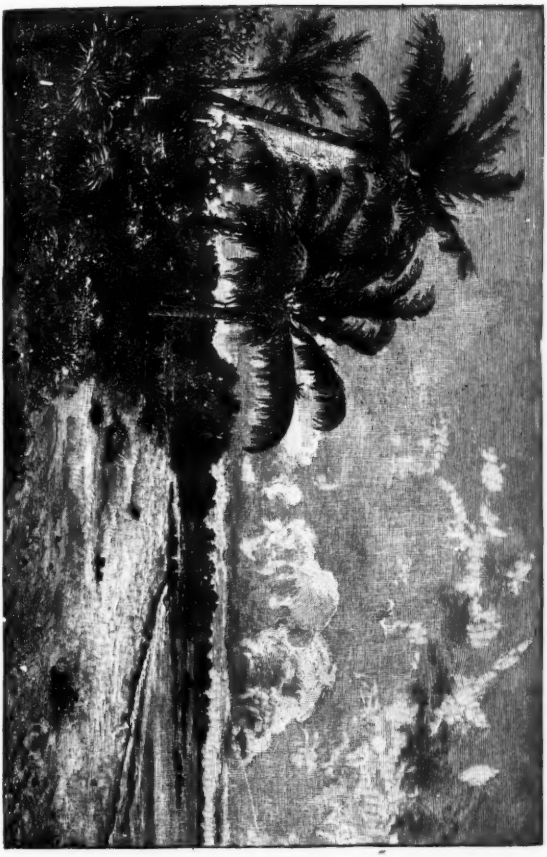
Miami University



View on Caroline Island.

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race, by A. Graham Bell. The greater part of the volume is devoted to the report of the eclipse expedition, the interest of which is enhanced by the photographs reproduced in its pages.

Caroline island is a genuine atoll, of the type described by Darwin and Dana; while the frontispiece gives a bird's-eye view of the low circular island, the four accompanying illustrations will convey an idea of the scenery of a Pacific atoll. The surface of the island is covered with palms and undergrowth, including a large number of young cocoa palms planted by the owners of the island, who keep a few people on the island to cultivate them. Beside the eclipse and other physical data, the botany of the island is described by Dr. W. S. Dixon, U.S.N., and Professor W. Trelease; Dr. Dixon also adds notes on the zoölogy of the island. The few butterflies have been named by Messrs. Arthur Butler and H. Stricker. The whole presents an interesting monograph of an atoll. Plates XXVIII–XXXI are from electrotypes of four of the views taken on the island.

Dr. Krauss' Slavic Customs.—In his latest publication, the ethnologist Dr. Friedr. S. Krauss has taken up the subject of the tribal and family relations, of domestic life, courtship, marriage, married life, divorce, adoption, widowhood and hospitality among the Southern Slavs of the Balkan peninsula. From the title, "Sitte und Gebrauch der Südslaven" (Customs and uses among Southern Slavs)[1] we would certainly expect a full treatment of other subjects of popular life, also, as of legal customs, agriculture, pastoral pursuits, etc., included in the volume; but what is offered is so well marked with the stamp of learning and thoroughness that we do not grudge with the author for the rest, expecting to find it in subsequent volumes. The work was undertaken in 1883 under the auspices of the Vienna Anthropological Society, and carried out through the munificence of Baron Ferd. von Andrian-Werburg. A considerable literature already exists on the subject, as may be collected from the preface of another important work of Krauss (on the Folklore of Southern Slavs, a serial, of which two volumes have hitherto appeared), but the author is perfectly independent of his predecessors, has himself visited a large portion of the countries described, and speaks several of their dialects. The "Customs" are interspersed with many quotations from Slavic poets and from popular poems, of which the authors are unknown, sometimes also with quotations from the original languages. But he avoids on purpose ethnologic comparisons with facts taken from non-Slavic especially non-European institutions, as the conditions under which they originated may not always be the same as the ones observed at home. It is interesting to see how the tribe of the

[1] Sitte und Brauch der Südslaven. Nach heimischen gedruckten und ungedruckten quellen, von Dr. F. S. Krauss. Wien, 1885. A. Hölder, publisher. 8vo, xxvi and 681 pages.

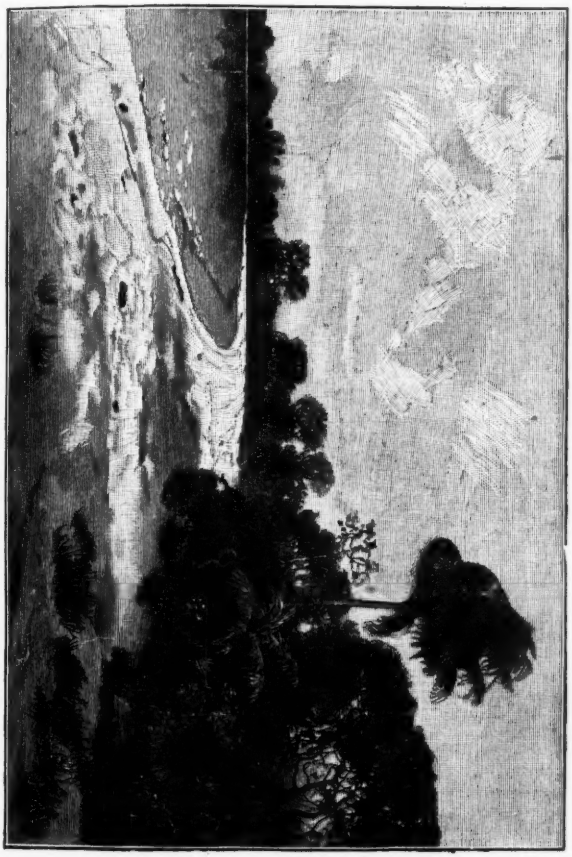
ancient period (zupa or pleme) has gradually changed into the modern tribe, bratstvo or *brotherhood*, and in which manner all the family relations have assumed another shape also. It is true that many of these Slavic practices and customs are barbaric or have originated in a barbaric age, that some of the superstitions are exceedingly repulsive, and that the position of woman is far from what it ought to be or even from what it is now among the nations of Western Europe. Nevertheless a certain spirit of poetry hovers over these populations, which are isolated from the rush of the world's commerce and have been so long subject to the iron rule of the Turk. Their love for music, poetry, dance, mimicry and fairy tales lets them forget many of their tribulations and miseries of everyday life, and here in Krauss' book are gathered the most naïve and surprising utterances of the popular spirit. The long and useful alphabetical index was made by a young lady of the village of Mikanovci, whose name is mentioned in the preface.—*Albert S. Gatschet.*

KINGSLEY'S MADAM HOW AND MADAM WHY.[1]—Charles Kingsley was no ordinary man, and no ordinary writer, and the republication among the Globe Readings of his little work, Madam How and Madam Why, will doubtless be welcomed by many of the class of little ones for whom it was written. It is true that to an adult the impersonation of method and reason as "Madam How" and "Madam Why," and that of analysis and synthesis as giants seems too metaphorical and somewhat old-fashioned, yet the charm of the style cannot be denied. A deeper objection to the title is, that we do not know the "how" or "why" of anything—we name the forces which move nature's scenery, but we understand them not. No one knew this better than Charles Kingsley, as may be seen by what he has to say with regard to analysis and synthesis. As a book for American children the value of this treatise is impaired by the fact that all the allusions and illustrations are European, or rather British.

EYFERTH'S NATURGESCHICHTE DER MIKROSKOPISCHEN SUSSWASSER BEWOHNER.[2]—This is a handy book for the student of fresh-water microscopic life, animal and vegetable, and appears to be tolerably well brought up to date. The leading authorities are given, while short family descriptions, a key to the genera, and a brief characterization of the genera and of quite a large number of species give all that is necessary to enable the observer to place any particular form among its relatives. The work is well indexed, and illustrated by seven full-page plates.

[1] *Madam How and Madam Why, or First Lessons in Earth-lore for Children.* By CHARLES KINGSLEY. New York, Macmillan & Co., 1885.

[2] *Die Einfachsten Lebensformen des Thier-und Pflanzenreiches.* Naturgeschichte der Mikroskopischen Süsswasser bewohner. Bearbeitet von B. EYFERTH. Braunschweig, Von Goeritz und zu Putlitz, 1885.



View on Caroline Island.

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GATSCHET'S "A MIGRATION LEGEND OF THE CREEK INDIANS."[1] —This publication brings forward some scientific results obtained while studying the language and ethnology of the Creeks and their congeners. It commences with an account of the southern families of Indians, and concludes with the Kasi'hta migration legend. The settlements of the Creeks, their government, war customs, initiation and other ceremonies, history and dialect are described.

RECENT BOOKS AND PAMPHLETS.

Graf, L. von—Ueber einige Deformitäten an fossilen Crinoiden. Abd. der "Palæontographica," 1885. From the author.

Newberry, J. S.—The eroding power of ice. Rep. from School of Mines Quarterly, 1885. From the author.

Scudder, S H.—The earliest winged insects of America. 1885.

——Palæodictyoptera, or the affinities and classification of Palæozoic Hexapoda.

——Winged insects from a palæontological point of view. The last two from Mem. Bost. Soc. Nat. Hist., 1885. All from the author.

Gill, Th.—An account of the progress in zoölogy in the year 1883. From Smithsonian report, 1883. From the author.

Lord, E.—Comstock mining and miners. U. S. Geol. Surv., 1883. From the author.

Will, L.—Bildunggeschichte und Morphologischer Werth des Eies von *Nepa cinerea* L. und *Notonecta glauca* L. 1885. From the author.

Moseley, H. M.—Notes on the structure of Striatopora, Pocillopora, Corallium and Tubipora. 1882.

——On the pharynx of an unknown Holothurian of the family Dendrochirotæ. 1884.

——On the presence of eyes in the shells of certain Chitonidæ. 1884. All from the Quarterly Journal of Microscopical Science and from the author.

Mus. D'Hist. Nat.—Rapports Annuels de MM. les professeurs et chefs de service. Paris, 1882.

Fordice, M. W., and Eigenman, C. H.—A review of the American Eleotridinæ. Ext. Proc. Nat Sci. Phil., 1885. From the authors.

Brinton, D. G.—The lineal measures of the semi-civilized nations of Mexico and Central America. 1885. From the author.

Lyman, B. S.—A review of the Atlas of the western middle Pennsylvania anthracite field. Rep. Ming. Herald, Dec., 1884. From the author.

Shufeldt, R. W.—Variations in the form of the beak that take place during its growth in the short-tailed albatross. From the Auk, 1885.

——The osteology of *Amia calva*. Ext. Ann. Rep. Comm. Fish and Fisheries, 1885. Both from the author.

Holbrook, M. L.—The termination of the nerves in the liver.

——The structure of the muscles of the lobster. Both from the Rep. Proc. Amer. Soc. Micros., 1882, and from the author.

Lupton, N. T.—Meteoric iron from Coahuila, Mexico. Ext. Amer. Journ. of Science, Vol. XXIX, March, 1885. From the author.

Smith, Miss R.—Notes on fishes collected at San Cristobal, Lower California, by Mr. Chas. H. Townsend. Ext. Proc. U. S. Nat. Mus., 1884. From the author.

Fritsch, A.—Fauna der Gaskohle und der Kalksteine der Permformation Böhmens. Band II, Heft II. Prag, 1885.

——Ueber der Auffindung eines Menschenschädels im diluvialen Lehm von Strebichovic bei Schlan. Both from the author.

[1] *A Migration Legend of the Creek Indians.* By ALBERT S. GATSCHET. Vol. I. Philadelphia, D. G. Brinton, 1884.

Fischer, J. G.—Ichthyologische und herpetologische Bemerkungen. Hamburg, 1885.

Goode, G. B.—Bulletin of the U. S. National Museum, No. 27. Descriptive catalogue constituting a report upon the exhibit of the fisheries and fish culture of the U. S. A., made at the London Fisheries Exhibiton, 1883. From the Dept. of the Interior.

Smithsonian Institution.—Bulletin of the Philosophical Society of Washington, Vol. VII, 1885. From the institution.

Mills, C. K.—Toner lectures, No. IX. Mental overwork and premature disease among public and professional men. 1885. From the author.

Taylor, W. B.—The refraction of sound. Ext. Smithsonian report, 1885. From the author.

Mason, O. T.—An account of the progress in anthropology in the year 1883. Ext. Smith. rep., 1883. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*The Sanpo and the Irawadi.*—The chief paper in the May issue of the Proc. Roy. Geog. Society is upon the disputed question of the sources of the Irawadi. As no one has yet followed the Sanpo from Thibet downwards, it is still unproved whether it enters the Irawadi or the Brahmaputra. Mr. Robert Gordon opposes the commonly received idea by advocating the Irawadi view. He bases his belief upon the following points:

(1) The Salween, which flows to the east of the Irawadi, has been proved to rise north of latitude 30°, and thus the country which was formerly supposed to supply the Irawadi is now known to be the watershed of the Salween.

(2) The Irawadi at Bhamo, the point where it first became known to western geographers, is still one of the largest rivers in the world, containing probably two-thirds of its volume in the delta. The average discharge at the delta is about 521,794 millions of cubic yards, very nearly four-fifths of that of the Mississippi. But three-fourths of this vast discharge come down in the months of July, August and September. August has twenty-two per cent of the entire discharge, February and March only one and a half per cent. At Bhamo Mr. Gordon calculates the ordinary high-water capacity at 900,000 cubic feet per second.

(3) Chinese geographical annals, extending over twelve hundred years, and corroborated by the direct statements of French missionaries and others, give direct evidence that the Sanpo is the Irawadi, and maps, names of rivers, etc., give indirect evidence to the same effect.

Mr. Gordon quotes Count Szechenyi as follows: "Almost all the Tibetans who could furnish information about this country gave as an answer to my question, 'Where does this river come from?' 'From Lassa.' According to Chinese and Tibetan

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

sources, the Irawadi is no other than the lower course of the Tibetan Sanpo."* Not only do the old Chinese geographers connect the Sanpo with the Irawadi, but the Chinese official map, made after the surveys of the French missionaries in the last century, does the same. The imperial geography of the Thung dynasty (617–907 A.D.) says that the great Kin-sha-Kiang is made up of two rivers and then passes by Mano and Tchenago (Bhamo and Tshempenago). It adds: "There is no doubt that this river is the Yaroo Sanpo of Thibet." The Emperor Kang-hi says that the Yaroo Sanpo enters the kingdom of Burma. The Yunnanese call the Upper Irawadi the Ta-Kin-sha-kiang, or Great Kin-sha river, while the Yang-tse-kiang is the Sui Kin-sha-kiang, or Little Kin-sha river. Ta-Kiu-kiang, the official Chinese name for the connecting link between the Sanpo and the Irawadi is identical with Nam-Kiu-long, the name given by the Shans who live upon it, both meaning the Great Kiu river. The explorations of Hindoo surveyors have carried the Sanpo to the east of the point where it was formerly supposed to enter Assam, but the lower courses of the affluents of the Brahmaputra were immediately twisted upon the maps so as to still show the union of the Sanpo with the Brahmaputra.

(4) It is impossible, on the supposition that the Zayul-Chu is the upper course of the Eastern Brahmaputra and the Sanpo that of the main branch of that river, to account for the volume of water in the Irawadi at Bhamo. A drainage area of from 5000 to 8000 square miles, which is all that could in such a case be left to the Irawadi, could not possibly yield so great a volume.

(5) The Zayul-Chu, which is said to be the Eastern Brahmaputra, may prove to be an affluent of the Irawadi. Mr. Gordon goes into elaborate arguments to show that Rima and Sama, places upon this river, are some thirty miles farther to the north-east than they are placed by Captain Wilcox (who did not visit them). In this half degree there is room for the Sanpo to flow to the Irawadi. The volume of the Zayul-Chu is greater than that of the Upper Brahmaputra.

(6) The Brahmaputra influents, even if the Sanpo is barred out by the range of mountains upon its southern and eastern borders, have basins sufficiently large to account for their dimensions. The Subansiri has 7000 square miles and a discharge of 240,000 cubic feet per second; the Eastern Brahmaputra 7000 square miles with 326,000 cubic feet, and the Dihong, which some believe to be the Sanpo, would without it have 7500 to 12,000 square miles, which, in the rainy climate of the southern slopes of the Himalayas, would account for its volume of 423,000 cubic feet per second.

In reply General J. T. Walker attacked particularly the arguments connected with the Zayul-Chu, certainly the weakest part of Mr. Gordon's paper.

Corea.—According to Mr. Carles there is in Corea a great disproportion between the numbers of the sexes, the males being the more numerous. There seems to be no evidence of female infanticide, but a greater number of deaths among girls in infancy. As a land of large hats Corea is unsurpassed. At Phyong Yang, a large town on the west coast, the hats worn by the poor women are baskets three and a half feet long, two and a half wide and two and a half deep, which conceal their faces as effectually as does the white cloak which women of a better class wear over their heads. The men wear a somewhat smaller basket of the same shape. It requires both hands to keep it in place. A similar structure, of a size but little larger, is used to cover fishing boats. The monument erected over the grave of a doctor of letters is the trunk of a tree painted like a barber's pole up to a height of some thirty feet. The top and branches are cut off, and on the summit is placed a slim carved dragon twenty feet long, with a head like that of an alligator. Mr. Carles reports, contrary to the statements of some other travelers, frequent evidences of mineral wealth.

M. de Mailly-Chalon's Journey.— M. de Mailly-Chalon gives in the Bulletin de la Société de Geographie a paper on a journey in Manchuria, from Peking through Kirin to Ninguta, and then along the Tiumen to Vladivostock. The journey the whole way was along the Corean frontier. From Vladirostock the travelers proceeded to Tomsk, thence to Samarkand, through Karshi to Bokhara, to the Amou-Darya at Charjni, down that river to Petro-Alexandrovsk, thence to Khiva, and lastly across the Kara-Kum to Merv, Sarakhs and Meshed.

Oceanica.—*New Zealand.*—The April issue of the Proceedings of the Royal Geographical Society contains an account of a recent exploration of the King country of the North island, New Zealand. This country, containing some 10,000 square miles, is the Maori stronghold, and white men were, after the war of 1863–64, forbidden to enter under pain of death. It had thus never been surveyed prior to Mr. Kerry-Nicholl's expedition in 1883. In the course of 600 miles of travel twenty-five rivers not previously shown upon the maps, and two small lakes, were found; the sources of the four principal rivers of the colony, the Whanganui, Waikato, Whangaehu and Manganui-a-te-Ao, were traced; the hydrography of Lake Tanpo in relation to the four distinct watersheds flowing into it was examined; the volcano of Mt. Tongariro (9300 feet) and Mt. Ruapehu (9000 feet), the highest peak of the North island, were ascended, and the geological structure of the Kaimauawa mountains was made out. The region of Lake Taupo is an extended tableland varying from 1500 to 3000 feet in height. In its center lies Lake Taupo, covering over 300 sq. miles and 1175 feet above the sea. Seventeen

rivers, besides smaller streams, run into this lake, while the only river flowing out is the Waikato. The southern part of the tableland, known as the Rangipo plateau, rises to 3000 feet, while the part near Lake Taupo is about 2000 feet. Tongariro's active crater is nearly a mile in circuit. Ruapehu is among the largest extinct craters in the world, and is not a cone of scoria like Tongariro, but a gigantic crater of elevation with a base sixty miles around. The Kaimauawa mountains are almost in the center of the island, attain about 600 feet, and extend along a base of about eighty miles.

The Whangaehu river, which rises on the eastern side of Ruapehu, is one of the largest streams in the island, and descends by a series of grand cascades. The waters of the Upper Waikato burst from the sides of Ruapehu very near the Whangaehu, and the streams for a while run parallel, though afterwards they run in opposite directions. The finest forest in New Zealand is that of Te Rangikaika, which covers some 3000 square miles between Ruapehu and the west coast. Mr. Kerry-Nicholls reports that the Maori race is greatly on the decrease.

South America.—*Roraima.*—Particulars of Mr. Im Thurn's ascent of Roraima, with some illustrations, are given in a recent number of *Nature*. Koraima and Kukenam are separated by a wide gorge, and seem like two fortresses, with walls 1200 to 1800 feet high, built upon a mountain top 7000 feet in height. The north, east and west sides of Roraima are forest-crowned, but on the south and south-west it is for the most part devoid of trees up to 5890 feet. From here to the cliff-face the slope is steeper and covered with thick undergrowth with few large trees. The cliff of Roraima was ascended by following a ledge of rock running from the tree-covered part up to the summit. The botany of the slope was very interesting, but the top itself is covered with an extremely scanty and insignificant vegetation. There are several pools of water, and on all sides are grouped rocks of the strangest and most fantastic forms—portions of the solid sandstone on which they rest. Bushes three to six feet high, a few scrubby orchids, two species of thick-leafed ferns and a variety of the red Utricularia which grows below, comprised the botany. There is no soil, and no fossils were found.

The Saskatchewan Region.—G. M. Dawson (*Science*, April 24) describes the Saskatchewan country or that portion of the prairies which extends north of the northern boundary, as containing an approximate area of 300,000 square miles, and as less than 2000 feet above the sea-level, and thus lower than the corresponding portion of the continent further south. Parts of this area are characterized by scattered groves of aspen and other trees. The Red River valley has an altitude of 800 feet only, and from this level the surface slopes gradually upward at the rate of four to

five feet to the mile to the foot-hills. There the horizontal and unaltered strata of the Cretaceous and Laramie formations break against the base of the ancient rocks of the mountains into a series of sharp and nearly parallel flexures. In the central portion of the plains are a tumultuously hilly belt known as the Missouri Coteau, and also a line of indefinite elevations nearly parallel to the Coteau. The most remarkable difference between this region and that west of the Missouri is perhaps the extraordinary abundance of small lakes or "sloughs," evidently connected with the mantle of glacial drift. These usually occupy shallow basins without outlet, many are emptied by evaporation before autumn, and others from the same cause become more or less saline. The North and South Saskatchewan, Red Deer, Bow, and Belly rivers rise far back in the Rocky mountains, and while subject to considerable spring freshets, are generally not in full flood till June or July.

The Xingu. — Dr. Clauss recently gave, before the Munich Geographical Society, an account of his explorations of the watershed between the Paraguay and the Amazon. This watershed is 300 to 400 meters high, and is a savannah broken up by forests along the water courses. The watersheds between the tributaries of the Amazons in this region are unknown. Brazilian geographers direct the upper course of the Xingu to the Tapajos, and put the source of the former under 11° S. lat. Eight days after the expedition had crossed the last tributary of the Tapajos they reached a large river which they named the Rio Batovy, and descended in bark canoes to the Xingu. The inhabitants of some Bucairi villages were found to be utterly ignorant of metals. From 8° to 3° S. lat. the Xingu falls 200 meters in a series of cataracts which were successfully passed under the guidance of the Yaruna Indians.

EUROPE.—Dr. F. Suenonius believes that the word "lapp" is derived from *lappa* or *lappah*, "cave" or "recess," a name given by the Scandinavians because the Lapps of earlier times lived in caves or recesses. The mountains of Swedish Lapland are partly Alpine, composed of hornblende, gabbro and eklogite, but principally low rounded "grass" mountains of schist impregnated with chalk. The highest parts of Swedish Lapland are around the sources of the Rapaädnos and west of Lake Paijasjärvi, and in these regions the largest Swedish glaciers occur. About 180 square kilometers are covered with "eternal" ice, reaching several hundred feet in depth. The surface area of the lakes is about one-third of Swedish Lapland.

The Hungarian Society of Geography is engaged in organizing a Magyar expedition for the exploration of the region round the Urals, especially the Baskir country, where Uralo-Altaú peoples are disappearing.

AFRICA.—*African News.*—Dr. Oscar Lenz was sent by the Imperial Geographical Society of Vienna to explore the watershed between the Nile and the Congo. He started in May. ——The Austrian explorers, Dr. Paulitschke and Dr. von Hardegger have returned from the Gallas country. They were amicably received by the Egyptian governor of Harrar. On their return (March 25, 1885) they found Zeila half in ruins.——A government commission has inspected and reported upon the Tunisian forests. In the districts south of the Medjerda valley the so-called forests are a mere brushwood with groups of larger trees, but on the Krumis mountains to the north, exist magnificent forests with trees equal in size to those of France, including cork trees and *Quercus mirbockii.* One forest covers 100,000 hectares.

GEOLOGY AND PALÆONTOLOGY.

THE MAMMALIA OF THE OLIGOCENE OF BUENOS AYRES.[1]—This memoir, by M. Ameghino, is one of much importance to the history of the Mammalia, and especially to the history of the Pampean and recent faunæ of the neotropical realm. Ever since M. Bravard announced the existence of species of Palæotherium and Anoplotherium in strata within the limits of the Argentine Confederation, the curiosity of palæontologists has been awaiting an explanation of a statement apparently so at variance with the known facts of the science. M. Ameghino, aided by the labors of Professor Scalabrini, has fortunately resolved this problem, and with it has set before us a record of uncommon interest to the students of the Mammalia and of their evolution.

The strata which have yielded the collections studied, are situated on the Parana river. The number of species obtained is sixty-two, which are referred to forty genera, which are distributed into orders as follows: Cetacea 3; Carnivora 3; Artiodactyla 2; Perissodactyla 5; Toxodontia 4; Rodentia 11; Edentata 17. Of these forty genera, sixteen also occur in the Pampean fauna.

Of these forms it is not to be supposed that all have been fully elucidated and their places finally ascertained. This is especially true of the ungulate orders, where the much-needed determination of the foot structures has not yet been made. We may therefore wait until this is done before accepting the reference of the genus Brachytherium Amegh. to the Anoplotheriidæ, or Ribodon Amegh. to the Tapiridæ. The references of the other genera to families characteristically Pampean, is so highly probable as to require less exhaustive demonstration to command belief. It is in these groups that the most interesting contribu-

[1] Nuevos Restos de Mamiferos Fósiles Oligocenos Recogidos por el Prof. Pedro Scalabrini y pertenencientes al Museo provincial de la Ciudad del Parana; por Florentino Ameghino. Buenos Ayres, 1885, pp. 204. (Extract from the Bulletin Nat'l Academy Sciences, Cordoba, VIII, p. 5.)

tions to the history of the evolution of the well-known Pampæan genera have been made. Thus a series is traced backwards in time from Toxodon, which shows that in the more ancient types the dentition was less rodent-like, since the molars were shorter and the canines larger. This adds evidence to the opinion which the writer has reached, that rodent-like types are not primitive but derivative.[1] Protypotherium is believed by Ameghino to be the ancestor of Mesotherium. Scalabrintherium stands in the same relation to Macrauchenia. As to the Edentata, the cases of evident ancestral relation are numerous, and are expressed in such names as Promegatherium Amegh., Promylodon Amegh., Palæhoplophorus Amegh., and Protoglyptodon Amegh. Perhaps the most interesting fact in this connection is the existence of more or less enamel in bands on the teeth of the gravigrades of this formation, proving that the history of the dentition of the Edentata has been one of degradation, as the writer had already concluded before reading M. Ameghino's memoir.[2] This fact is confirmatory of the theory of descent of the Edentata from the Tæniodonta, proposed by myself in 1877.[3]

The rarity of Carnivora in this formation is remarkable, there being but two terrestrial forms, Cynonasua Amegh. and ? Arctotherium. The rodents are remarkably numerous, twenty-one species being described. Important among these is the genus Megamys, which includes the largest species of the order, *M. patagoniensis* Laur., and which Ameghino places in the Chinchillidæ. Twelve of the species are referred to the Caviidæ.

We do not understand the ground of reference of this formation to the Oligocene. The cacophony of many of the new names proposed is somewhat surprising. The Latin languages of Europe are the most euphonious, but some of the naturalists of those races appear in latter years to have forgotten their cunning.

The further elucidation of this fauna, by so able an anatomist as M. Ameghino, will be awaited with much interest.—*E. D. Cope.*

ON THE GAMPSONYCHIDÆ, AN UNDESCRIBED FAMILY OF FOSSIL SCHIZOPOD CRUSTACEA.[4]—The opportunity of examining at my leisure about a dozen specimens of *Palæocaris typus* of Meek and Worthen, kindly afforded me by Messrs. R. D. Lacoe and J. C. Carr, has enabled me to work out some characters of this genus not mentioned by the original describers. The study of these specimens has led me to compare the genus with Gampsonyx, and the result has led to the formation of a family or higher group for the two genera, which should probably stand at the base of the Schizopoda, while also serving to bridge over the chasm

[1] See NATURALIST, 1885, p. 347, for the origin of the Rodentia from the Tillodonta, etc.

[2] See NATURALIST, 1885, p. 352, and 1884, p. 1257.

[3] Report Expl. Surv. W. 100 Mer., G. M. Wheeler, IV, pt. II, p. 158.

[4] Read at the April meeting of the National Academy of Sciences.

existing between the thoracostracous suborders Syncarida and Schizopoda.

Palæocaris was first described by Messrs. Meek and Worthen in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1865, p. 48, from specimens occurring in claystone nodules in the lower part of the true coal measures, at Mazon creek, Morris, Grundy county, Illinois. Afterwards in the third volume of the Report of the Geological Survey of Illinois, 1868, the same authors figured the fossils and expressed themselves as follows regarding its affinities: "Hence it would seem to present something of a combination of decapod (macruran) and tetradecapod characters. That is, it possesses the caudal appendages, anteriorly-directed thoracic legs, the antennæ (some of the specimens appear also to show basal scales to the outer antennæ), and general aspect of a macruran, with the distinct head, divided thorax (without a carapace) and seven pairs of thoracic legs of a tetradecapod. We have not been able to see its eyes, but from its other decapod characters, and its analogy to Gampsonyx, which is said by von Meyer to have pedunculated or, at any rate, movable eyes, we are strongly inclined to believe that our fossil will be found to agree with Gampsonyx in this character also.

"It therefore becomes a matter of interest to determine to which of the subclasses, decapods or tetradecapods, it really belongs. That it belongs rather near Gampsonyx, though not to the same subordinate section (Schizopoda), there can be little doubt. Hence these two forms apparently fall naturally into the same family. Professor Jordan and Mr. Meyer seem to have regarded Gampsonyx as a tetradecapod, connected with the Amphipoda, but also possessing macrural decapod affinities. Professor Dana, however, regards it as a low type of Macrura belonging to the section Schizopoda. He and Dr. Stimpson, to whom we sent sketches of our better specimens of Palæocaris, concur in the opinion, judging from all its characters yet known, that it is a low embryonic type of the Macrura, in which the carapace is not developed.

"Generically it is separated from Gampsonyx, figures of which (cuts *C* and *D*) we have added for comparison, not only in the nature of its caudal appendages, but in the more important character of having its thoracic legs simple, and not bifid as in the Schizopoda."

In our specimens we were able to detect well-marked narrow lanceolate oval breeding lamellæ on eight pairs of appendages.

It should be observed that the breeding lamellæ are in part represented in Meek and Worthen's figure, but not referred to in their description; they are also partly represented in their copy of Jordan and Mr. Meyer's figure of *Gampsonyx fimbriatus;* in the latter there is also present what is apparently a large coarsely-spined mandibular palpus, somewhat like that in the male of the existing deep-sea schizopod, *Petalophthalmus armatus*, described

by Willemoes-Suhm.[1] In the females, however, the palpus is small and unarmed, and it is probable that all my specimens of Palæotypus are females, since most of them have breeding lamellæ. In the figure of Gampsonyx referred to, the thoracic legs themselves, irrespective of the breeding lamellæ, are represented as biramous, and the two rami are drawn as of nearly equal length; it is probable that there has been a mistake in drawing the legs, as in none of the existing schizopods, such as Mysis and allies, Euphausia, Gnathophausia, Petalopthalmus or Chalaraspis, are the legs thus thrice divided. It is to be hoped that the fossil itself will be examined anew with regard to this important point.

It is sufficiently evident, however, that Gampsonyx and Palæocaris are closely allied forms, and as suggested by Messrs. Meek and Worthen, should fall into the same family, which may be called Gampsonychidæ. The principal character which separates this group from all other schizopods is the entire absence of a carapace.

It is worthy of notice, however, that the size of the carapace is very variable in the Schizopoda, and in the genus Petalophthalmus there is a great discrepancy in the two sexes; in the female it covers the entire thorax, while in the male it is remarkably small, subtriangular, leaving the two hinder thoracic segments entirely exposed, as well as the sides of the two segments in front. In the large size and oval-lanceolate shape of the breeding lamellæ, both of the gnathopods (maxillipedes) and thoracic feet, the Gampsonychidæ agree with Petalophthalmus, in which they are large and broad. In the shape of the telson and the comparative size and proportions of the last pair of abdominal appendages there is a close relationship in the Gampsonychidæ to the schizopod genera Petalophthalmus and Chalaraspis, especially the latter genus, in which the telson is rounded at the end, while the two rami are more as in Petalophthalmus, though broader. The other biramous abdominal appendages in the Gampsonychidæ are truly schizopodal.

Classifying the Schizopoda by the carapace, there would seem to be three groups, as follows:

I. Carapace absent..... *Gampsonychidæ.*
II. Carapace free, varying in size.. *Gnathophausia. Petalophthalamus, Chalaraspis.*
III. Carapace fastened to the thorax..... *Mysis, Lophogaster, Cephanoia.*

But I should agree with Willemoes-Suhm that this is not a natural genealogical classification, and throwing out the Nebaliadæ, which we have endeavored to show belong to a distinct order of Crustacea, the families of schizopods may be enumerated thus, all having seven abdominal segments:

Carapace absent, 6 pairs of thoracic legs..... I. *Gampsonychidæ.*
Carapace well developed, 6 pairs of thoracic legs..... II. *Mysidæ.*
" " " 8 " " " .....III. *Euphausiidæ.*
" " " 4 " " " .....IV. *Chalaraspidæ.*
" " " 7 " " " ..... V. *Lophogastridæ.*

[1] On some Atlantic Crustacea from the *Challenger* expedition. By Dr. R. von Willemoes-Suhm. Linnæan Transactions. Zoölogy. Vol. I, p. 23, 1874.

When we compare the Gampsonychidæ with the Syncaridæ (Acanthotelson), we see that both groups have the same number of body-segments, and that both lack a carapace; and thus while the Gampsonychidæ are the ancestors of living schizopods, the group as a whole probably descended from Acanthotelson, which is thus a truly synthetic form, standing in an ancestral relation to all the Thoracostraca, while it also suggests that the sessile-eyed and stalk-eyed Crustacea may have had a common parentage.

GEOLOGICAL NEWS.—*Silurian.*—Various studies by W. C. Brogger, upon the Silurian strata of Norway and their contained fossils, are published in the Magazin fur Naturvidenskaberne, Christiania, 1878–1882–1884, and furnish new data for a comparison between the Scandinavian, German and English Silurian.

Devonian.—P. Wenjukoff has published (in Russian) a work upon the Devonian strata of European Russia, with a table of comparison with the beds of Belgium and Eifel. It appears that the Russian beds belong to the Middle and Upper Devonian.

Carboniferous.—MM. B. Renault and E. E. Bertrand have found incontestable proof of the existence of fungi in Carboniferous times. In the tissue of the seed of a conifer of this epoch (*Spherospermum oblongum*) the mycelium of a fungus was found, consisting of threads which were lengthened out or irregularly bunched together, according to the size of the cellules in which they were developed. The cellules of the hypla may be entirely or totally transformed into sporangia, in the latter case the part which touches a sporangium is furnished with a cuticle. Two sporangia are often thus separated by a cuticle cellule. The sporangia are ovoid, are swollen upon the side of the orifice. They are usually empty. The Grilletia are thus remarkable for their sporangia without a neck and without an operculum, and for their habitat in the seeds of gymnosperms. They must be placed near Aphanistis, Catenaria and Ancylistis.——The annals of the Belgium Royal Museum of Natural History, 1883, contain the fourth part of De Koninck's studies of the fauna of the Carboniferous Limestone of Belgium. This part is devoted to the Gastropods. Among new species are numerous Calyptræidæ, four of Helminthochiton, four Dentaliidæ and a small Hyolithes.

Mesozoic.—M. Bleicher (Bull. Soc. Geol. de Fr.) gives a stratigraphical study of the iron beds of Lorraine, belonging to the Upper Lias and Lower Oolite. From a comparison it appears that there is a great agreement between these beds in France and Germany and the corresponding ones in England.——M. Neumeyer (Denksch. d. kais. Acad. Wien, 1883) contributes his views upon climatic zones during the Jurassic and Cretaceous periods. In the first chapter, "Theory of the Climate of the Past," he combats the usual idea that before the beginning of the Tertiary the entire earth enjoyed an equable warm temperature through the

influence of the interior heat. In the next chapter is brought together all previous knowledge of climatic zones in Jurassic times, and the next treats of the characteristics of an Alpine Jura and a mid-European Jura. This is followed by a chapter upon the distinguishing features of an Alpine and a Mediterranean Neocomian. He finally thus classifies the zoögeographical provinces of Jurassic and Cretaceous times:

I. Boreal Zone.

1. Arctic province.
2. Russian "
3. Himalayan "

II. North Temperate Zone.

1. Mid-European province.
2. Caspian "
3. Punjab "
4. Californian "

III. Equatorial Zone.

1. Alpine (Mediterranean) province.
2. Crimo-Caucasic "
3. South Indian "
4. Ethiopian "
5. Columbian "
5*a*. Caribbean "
6. Peruvian "

IV. South Temperate Zone.

1. Chilian province.
2. New Zealand "
3. Australian "
4. Cape "

Tertiary.—Numerous plant impressions, together with remains of *Sus major*, *Hipparion gracile*, *Castor jægeri*, etc., have been found in the lignite beds which are interstratified with the lower layers of the Miocene of Cerdagne, an ancient lacustrine basin on the southern slope of the Pyrenees.——F. Fontannes writes of a new exposure of Miocene strata near Lisbon (Portugal), and describes the fossils found there, including a species of swimming-crab (*Achelous delgadoi*), the first representative of this tropical genus yet found in the Miocene. It occurs abundantly in the strata containing *Venus ribeiroi*.——"The classification and palæontology of the United States tertiary deposits." Under this head a note has been published in the number of June 12, of this journal, on the first part of my article, "The genealogy and the age of the species in the Southern Old-tertiary," *American Journal of Science*, June, 1885. I refer those readers of THE NATURALIST who are interested in this matter to the second part of this article, which will appear in the July number of the same journal.—*Dr. Otto Meyer, Yale College Museum, New Haven, Conn., June 15, 1885.*

Quaternary.—M. Stanislaus Meunier has described a Quaternary flint from the valley of Loing, forty-five mm. in diameter, containing not only a movable nucleus of stone, but a quantity of water. Such cases are well-known among quartz or concretions from amygdaloid rocks, but the example is said by M. Meunier to be unique among flints. The water must have come from the Quaternary bed in which the flint, itself of Cretaceous age, was lying, and must have penetrated the stone by permeating the silex.

MINERALOGY AND PETROGRAPHY.[1]

THE CLASSIFICATION OF NATURAL SILICATES.[2]—The author discussed the history of mineralogy, and noticed the method of classifying mineral species based solely on physical characters, which makes mineralogy a division of natural history. He then proceeded to consider the method of those who have arranged mineral species in accordance with the results of chemical analysis, disregarding or giving a subordinate place to physical characters. A true philosophy, it was contended, should keep in view both of these methods; the chemical cannot be separated from the physical study of species, and a thorough knowledge of the chemical constitution of these will show that their physical characters are intimately related thereto, and will lead to a natural system in mineralogy.

The author, in attempting the elaboration of such a system, begins by showing, in the present paper, its application to natural silicates. These he regards as polysilicates of high equivalent weights, in accordance with the view put forward by him in 1853, when wollastonite was referred to a polysilicic acid with $11SiO_2$, and pyroxene to one with $14SiO_2$, or some simple multiple of these numbers. In such compounds the degree of complexity of the molecule is shown by the relation to space of the chemical equivalent or, in other words, by its volume. To arrive at a term of comparison for this in species of various and unknown degrees of complexity the author deduces for each silicate the mean equivalent weight of its atomic unit, corresponding to an atom of NaCl, for which purpose H_2O and CaO are divided by two, SiO_2 by four, and Al_2O_3 by six. The mean unit-weight, P, thus deduced from any arbitrary chemical formula, divided by the specific gravity of the species, gives the volume of the unit V, which serves to show for different species the relative condensation of the molecule. The hardness and the chemical relations of species will be found to vary with the unit-volume.

For example, the simplest atomic ratio representing the two species meionite and zoisite (which have the same centesimal composition), is (ca.al2.si3) o6; the small letters representing atoms, and o = 8. This gives an equivalent of 107, which divided by six yields for the mean atomic weight of the unit in both of these species P = 17.83. Dividing this latter number by 2.7, as the specific gravity of meionite, we have for the atomic volume in this species V = 6.60, and by 3.4, as the specific gravity of zoisite, V = 5.24. The true formulas and equivalent weights of these polysilicates must be deduced from a comparison of their specific gravities with those of species whose equivalent weights are otherwise determined. Meanwhile it will be seen that zoisite, with the lower value of V or, in other words, the more condensed

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins University, Baltimore.

[2] Abstract of a paper read before the Nat. Acad. Sciences, April 21, 1885.

molecule, differs from the less condensed meionite by its greater hardness and its superior resistance to the action of acids.

From a consideration of the constitution thus assigned to silicates, it follows that the comparatively simple ratios generally deduced for the silica and the various bases are, in many cases, but approximations to the more complex ratios really existing. These, from the frequent impurities of natural silicates, can seldom be fixed with exactness, though with sufficient precision to give very nearly the values of P and V, which latter serves to determine the place of the species in the natural system of classification.

Water being an element universally distributed, its presence or absence in a silicate becomes of subordinate importance in determining alike the genesis and the natural affinities of species, so that the water-ratios are omitted in the tables of classification (which were shown), wherein the various natural silicates are, from the chemical side, considered with regard to the atomic ratios of fixed bases to each other and to the silica. There are genetic reasons for separating silicates of sesquioxyd bases, like alumina from protoxyd-silicates. The former of these constitute the class of Persilicates, and the latter the Protosilicates; those containing both protoxyds and sesquioxyds being designated Protopersilicates. Ferric oxyd and zirconia are classed with alumina as sesquioxyds, while titanic and boric oxyds in silicates are counted with the silica in determining the atomic ratios.

In the table of the Protosilicates, and in that of the Persilicates, both hydrous and anhydrous, the generally accepted ratios of the fixed bases to the silica are noted, but in that of the Protopersilicates regard is had to the more important ratios of sesquioxyds and fixed peroxyds to each other, inasmuch as the ratio of silica to both of these is found to vary greatly in closely related species, as may be seen in zeolites, feldspars, scapolites and micas. In these tables the three great classes of silicates are each arranged in groups, with primary reference to physical characters. Thus for Protosilicates we have in parallel columns, Pectolitoid, Spathoid, Adamantoid and Ophitoid, with each of which the range of values for V is given, while in an adjacent column to the left are inscribed the approximate atomic ratios of fixed protoxyds to silica. Among pectolitoids are included with pectolite, apophyllite and datolite, hydrohodonite, pyrosmalite, dioptase, calamine, cerite, thorite, etc. The spathoids embrace willemite, tephroite, gadolinite, helvite, leucophanite, wollastonite and tscheffkinite; the adamantoids, chondrodite, chrysolite, phenacite, bertrandite, hornblende, pyroxene, titanite, and danburite, while the ophitoids include various hydrous silicates, of which villarsite, serpentine and talc are representatives.

The Protopersilicates, in like manner, are grouped under the heads of Zeolitoid, Spathoid, Adamantoid and Phylloid, a subor-

dinate division to the latter being designated Pinitoid. In a column to the left are given the atomic ratios of sesquioxyds and fixed peroxyds, the silica being variable. The zeolitoids include besides the zeolites proper, forestite, prehnite, catapleiite, etc. Under the spathoids of this class are placed petalite, all feldspars and feldspathides, including iolite and sodalite, the scapolites, barylite, milarite, gehlenite, sarcolite, melilite, wöhlerite and eudialyte. The adamantoids include keilhauite, schorlomite, ilvaite, idocrase, garnet, allanite, beryl, euclase, ardennite, axinite, epidote, zoisite, jadeite, spodumene, sapphirine, staurolite and the various tourmalines. In the phylloids are included the whole of the micas from phlogopite and biotite, through seybertite, chloritoid, lepidolite and margarite to damourite and the muscovites. With the phylloids, and near the magnesian micas, come the various chlorites, while parallel with the non-magnesian or muscovite micas are placed the pinitoids, including besides pinite, or geiseckite, jollyte, fahlunite, bravaïsite, cossaite, gümbellite, etc.

The Persilicates are all gathered in two columns under the heads of Kaolinoid and Adamantoid, the received ratios of the fixed bases and silica being given in an adjacent column. The kaolinoids include the various hydrous silicates of alumina from the highly basic schrötterite, through kaolinite and halloysite, to to cimolite and smectite. With these are placed chloropal and also pyrophyllite. The adamantoid persilicates include besides dumortierite, fibrolite, cyanite and bucholzite, andalusite, topaz, the zircons and anthosiderite.

The relations of fluorine in silicates like topaz and chrondrodite, of chlorine in scapolites and sodalite; and of sulphur in lapis-lazuli, helvite and danalite are discussed at length by the author. Tables showing the values of P and V, together with the simplest atomic formulas deduced from chemical analysis are given for most well known silicates. The discussion of the equivalent weights of these species, and their definite place in a chemical classification of polysilicates is noticed, but is left for future consideration.

If we regard the silicates as constituting a natural order, the three groups already noticed may be called suborders; A. Protosilicates; B. Protopersilicates; C. Persilicates. The divisions of these designated Pectolitoid, Zeolitoid, Spathoid, Adamantoid, Phylloid, Ophitoid, etc., will constitute tribes. The tribal characters of the spathoids and the adamantoids being repeated in the suborders, we have A. and B. Spathoids and A. B. and C. Adamantoids. The subdivisions of these tribes into families, genera and species cannot here be discussed. The genus feldspar, including anorthite, albite and perhaps iolite, with other genera, some of which are represented respectively by orthoclase, by leucite, and by sodalite, will constitute the family of the feldspathides. The families of the micas and the pyroxenides in like manner will each include several genera, having different values for V.

The application of the principles above defined to carbonates, and the reference of the various carbon-spars to different polycarbonates, was long ago shown by the author in his papers already noticed. The extension of like views to all liquid and solid inorganic species, both natural and artificial, is but a matter of detail and labor, and when fully carried out will be the basis of a new chemistry.—*T. Sterry Hunt.*

MINERALOGICAL NEWS.—Dr. Carl Hintze contributes a paper on the chemical significance of crystallography, an address delivered on the occasion of his installment as "privatdocent" at the University of Bonn.[1]——F. Rinne[2] has investigated the crystallography of zincite on some artificial crystals from the zinc-furnaces of Lerbach in the Hartz, and finds the system hexagonal and axial ratio 1 : 1.621934. On the ground of etched figures produced by cold dilute hydrochloric acid as well as from the habit of the crystals, the author assumes that the mineral is hemimorphic with a decided resemblance to wurtzite.——Dr. Schuster,[3] of Vienna, describes an occurrence of fichtelite from a new locality—Salzendeich. It is found in monoclinic crystals $1\frac{1}{2}^{cm}$ in length. Twins are not uncommon, the twinning plane being the basal pinacoid.——H. A. Miers[4] gives a valuable monograph on the species bournonite, in which he adds to the list of fifty forms observed by former authors twenty-nine new ones of undoubted character, while twenty-one others are mentioned as doubtful. The same writer finds the hexoctahedron $\frac{3}{2}O\frac{9}{8}$ (986) on certain cuprite crystals from Cornwall, Eng., developed in accordance with the gyroidal hemihedrism of the regular system.[5] This has before only been once observed on artificial crystals of sal ammoniac by Tschermak.[6]——L. McCay[7] proves both by analysis and determination of specific gravity that a massive as well as a crystallized variety of safflorite (Co, Fe) As_2 occurs in nature. The specimens which he examined were from Schneeberg, in Saxony, where this substance is called by the miners "schlackenkobalt."——Messrs. Diller and Clarke[8] give the results of a microscopic and chemical study of the change of the topaz occurring at Stoneham, Me., to damourite. The alteration takes place along cracks in the topaz crystal, the transition, however, from the one mineral to the other being always abrupt. No intermediate product was observed. Professor Clarke appends some simple looking

[1] Ueber die Bedeutung krystallographischer Forschung für die Chemie. Habilitationsrede. Bonn, 1884.
[2] Neues Jahrbuch für Min., etc., 1884, II, p. 164.
[3] Ischermak's Min. und Pet. Mitth., II, 1885, p. 88.
[4] Mineralogical Magazine, VI. p. 69, 1884.
[5] Am. Journ. Science, 1885, May, p. 420.
[6] Tschermak's Min. und Petr. Mitth., 1881, p. 331.
[7] Am. Jour. Science, 1885, May, p. 369.
[8] Am. Jour. Science, May, 1885, p. 378.

structural formulæ for certain silicate minerals which are most interesting if demonstrable.—Tiffany & Co., of New York, have just published an illustrated catalogue of their collection of rough diamonds which so admirably exhibits all the phases in the crystallography of this interesting mineral. The collection embraces 904 stones weighing over 1876 karats, of these twenty-two are in the rock.——Dr. Konrad Oebbeke,[1] of Munich, has published some studies made upon crystallized minerals found in the andesites of Mt. Dore in Central France. Hypersthene, hornblende and pseudo-brookite receive especial attention.—— K. von Chrustschoff,[2] in the second part of his paper on secondary glass-inclusions finds that those observed in quartz fragments which have been imbedded in a liquid magma are due in all cases either to the infiltration of this magma into fissures or to the melting of some more easily fusible mineral which existed as an inclusion in the quartz before its imprisonment in the magma.——Professor Roland Irving, of Madison, Wis., in charge of the U. S. Geological Survey of the Archæan rocks of the Northwest, has just issued a most interesting paper on secondary enlargements of mineral fragments in certain rocks.[3] A large number of observations show the widespread growth of rounded quartz grains by subsequent deposits of silica, which acts as their cement. This phenomenon, which was first described by Sorby and has since received considerable attention from A. A. Young, Irving, and others, plays a most important rôle in the change of sandstones to quartzites. The enlargement in the same manner of feldspar grains by secondary deposits of feldspar substance was recently observed for the first time by Professor C. A. Vanhise, of Madison, whose paper is appended to the present work. The facts described are illustrated by a large number of excellent colored plates.

BOTANY.[4]

Branching of Pteris aquilina.—Much has been written on the structure of this well-known fern, but the relation of the fibro-vascular system of the stipe to that of the rhizome does not seem to have been traced. The widely-creeping rhizome *A* contains at the center two strong bands of sclerenchyma with two fibro-vascular bundles or rows of bundles between them, the whole surrounded by a ring of bundles much as in Fig. 1 *B*. In branching division occurs on a line crossing both bands of sclerenchyma, setting off to the branch a portion of both central bundles

[1] Bull. Soc. min. de France, 1885.

[2] Tschermak's Min. und Pet. Mitth., VIS, 1885, p. 64.

[3] Bulletin of the U. S. Geol. Survey, No. 8. Washington, Govt. printing office. 1884. (Price ten cents.)

[4] Edited by Professor Charles E. Bessey, Lincoln, Nebraska.

and of the outer ring, the divided bundle-ring afterwards closing up, leaving the arrangement the same as before.

If, however, the branch is to be a frond, a connection is soon formed between the two sclerenchyma bands, dividing both bundles or rows of bundles between them. The beginning of this connecting band is seen in Fig. 1 *B*, a section at the base of the stipe just above the point of attachment. When this connection is completed the bundles all lie in one continuous, though distorted ring, the enclosed sclerenchyma occupying the place of pith. From this point upward the band of sclerenchyma which lies on the anterior side of the stipe gradually diminishes

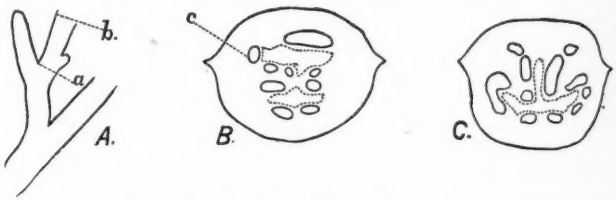


FIG. 1.—*A*, outline of a rhizome with base of stipe, *a–b*; *B*, a horizontal section at point *a*; *c*, a bundle which divides; *C*, horizontal section at the point *b*. The areas within the dotted lines are sclerenchyma, the others fibro-vascular bundles. *A* about one-half, *B* and *C* about twice natural size.

in size and finally disappears, while the one on the opposite side becomes broader, its edges bend forward and the bundles bordering upon it divide and increase in number. During these changes the front of the stipe becomes nearly flat and the back more convex, as in Fig. 1 *C*. Farther up all the sclerenchyma diminishes, and at the height of a few inches entirely disappears. The bundles, however, retain the same relative position and the pinnæ are given off right and left in the same manner as the branches of the stem.

In Fig. 1 *B* the bundle, *c*, divides and with part of the adjoining sclerenchyma enters the bud between *a* and *b* Fig. 1 *A*. In feeble plants this bud is suppressed and the branch at the left is reduced to a bud, so that the stipe then seems to arise directly from the main axis.—*A. A. Crozier, Ann Arbor, Mich.*

ATTEMPTED HYBRIDIZATION BETWEEN POND-SCUMS OF DIFFERENT GENERA.—In the latter part of May of this year, while examining a dish of material containing duckweeds (*Lemna polyrhiza*) and various fresh-water algæ collected in Southern Nebraska, I came across a case of attempted hybridization between two pond-scums (Zygnemaceæ) of different genera, which is well worth recording. The plants concerned were *Spirogyra majuscula* and *Mesocarpus scalaris*, both rather common pond-scums of our ponds and ditches. The normal mode of conjugation in this Spirogyra is by means of short lateral branches which unite so as

to form free passages between the conjugating cells, and through these the protoplasm passes from the one cell to the other, resulting in the formation of a resting spore (zygospore). In Mesocarpus the process differs in this that the protoplasm from both the conjugating cells passes into the connecting tube and there forms a resting spore. In the latter case the resting spore is thus inter-filar, while in the former it is intra-filar.

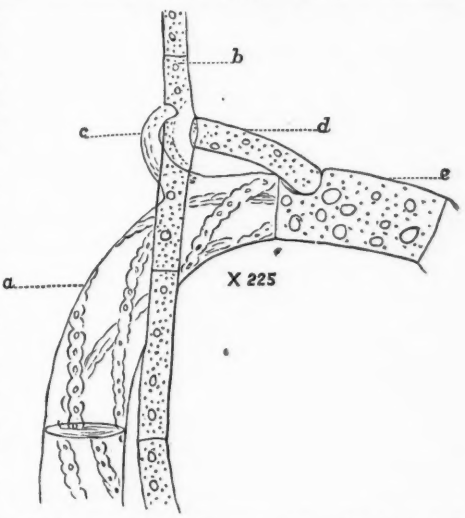


FIG. 1.—*a*, plant of *Spirogyra majuscula*; *b*, plant of *Mesocarpus scalaris*; *c*, conjugating tube sent out by Spirogyra; *d*, conjugating tube sent out by Mesocarpus; *e*, a dead cell of the Spirogyra plant containing parasites (Chytridium sp.).

The two plants lay parallel to one another, finally crossing, as shown in the figure. Near the point of crossing each plant sent out a characteristic conjugating tube. The tube from the Spirogyra was bent up and partly around the filament of Mesocarpus, while the tube of the Mesocarpus had pushed out against the Spirogyra filament with such force as to indent the latter very greatly.

The attempt at fertilization was futile, of course, and so no effort was made to keep the specimen alive. It was preserved in camphorated water and mounted upon a slide for further study and inspection.

We have in this case a suggestion of a reciprocal influence exerted by one cell upon another in the process of conjugation. It is probably a kind of sensibility to contact—an irritability, as the older vegetable physiologists would have called it. There was certainly a response to some influence on the part of one or other of these plants in the case before us. It is perhaps impossible to determine which plant took the initiative, whether the tube of Mesocarpus or of Spirogyra was first pushed out, but it is impossible to escape the conclusion that the second tube was pushed out in response to the first. It is possible that the first tube may have originally pushed out towards a filament of its own kind, and becoming displaced may have continued its growth towards the

stranger plant, exciting in it the production of a conjugating tube. I may say in conclusion that the position of the filaments and their appearance, under the microscope, precluded the supposition of an accidental juxtaposition.—*Charles E. Bessey.*

More Popular Botany.—A recently published little book, "Talks Afield," by Professor L. H. Bailey, adds another to the short list which this country as yet affords of readable scientific books on plants. We need not repeat here what we have said over and over again as to the duty of scientific men to prepare authoritative books which shall be written in non-technical language for the great non-scientific public. The author of the book mentioned has recognized this duty, and has given us a most readable as well as accurate volume. Twenty pages or so are given to a popular account of the greater groups of the vegetable kingdom, and then some of the most interesting features of flowering plants are taken up, as the flower, the stem, the rose family, the composite family, a peep at the inside, the sexes of plants, cross-fertilization, etc., etc.

We quote from pp. 74 and 75, as an example of our author's style: "The plant through its roots takes in various compounds which are dissolved in water. These compounds contain carbon, hydrogen, oxygen, nitrogen, sulphur, iron, potassium and other materials. The plant takes these solutions in through its roots by a modification of the phenomenon known to physicists as osmose, a sort of soaking-in process. The pressure exerted by the liquid as it comes into the root through this osmotic action forces the 'sap' upwards, but the chief cause of its rise is to be found in another fact: the stomata on the under surface of the leaves are open if the weather is clear and moist, and water is constantly evaporating from them. As fast as this evaporation takes place more water is needed. A demand is made upon the cells in the interior of the leaf which contain more water than those near the stomata, and as these interior cells lose some of their water they in turn call upon cells still more distant, and so on until the call is made all through the stem, and to the minute root-hairs which derive their water from the earth. This water does not flow upwards in tubes or cells, but it is soaked up through the thick walls of the wood-cells, and it keeps soaking upwards as fast as evaporation pumps it out through the leaves."

The publishers, Messrs. Houghton, Mifflin & Co., of Boston, have given the book a neat dress, and sell it for the reasonable price of one dollar.

The Botanical Club of the A. A. A. S.—There should be a good attendance of botanists at the meeting of the American Association for the Advancement of Science in Ann Arbor (August 26th to September 2d). Arrangements have already been made for excursions at low rates to the very interesting

Mackinac and Lake Superior regions. Botanists who are anxious to add to their collections can do so, and at the same time take a most enjoyable steamboat voyage upon the great lakes.

But let us ask here that the botanists do something to redeem the scientific reputation of their profession. It was a noticeable fact that for the greater part the papers presented by the botanists before Section F, last year, were characterized by far less depth than those which came from the other biological workers, the zoölogists. Is there a necessary reason for this in the nature of the two sciences, botany and zoölogy? Or is it a difference in men? May it not be due to a difference in habits of thought? Have not the botanists for so long thought of discovery as connected with new species that they have forgotten that there may be room for brilliant discovery in structural and physiological fields also?

Let our botanists prepare good thoughtful papers for Section F, and at the same time lay by numerous notelets for the Botanical Club, which will have frequent meetings during the association week. The club is intended to take in the shorter notes and lighter discussions which cannot properly find place in the section meetings.

Botanical News. — Centuries xiv and xv of Ellis' North American Fungi made their appearance a couple of months ago. The first is composed of miscellaneous plants of general interest. Century xv is devoted to the parasitic fungi, and contains seventeen species of Peronospora, seven of Uromyces, thirty-two of Puccinia, seven of Entyloma, besides many Æcidia and other imperfect forms. This volume is one of the most interesting yet published.——M. C. Cooke's Præcursores ad Monographia Polyporum, begun in the March *Grevillea*, is continued in the June number, the list reaching the 411th species. It is the intention of the author "to publish, in a collected form, all the scattered descriptions of the species known."——The last number of the *Journal of Mycology* contains a monograph of our species of the genus Ramularia. Work of this kind is much needed, and the new journal is doing good service in undertaking it.——Dr. Geo. A. Rex contributes a valuable and interesting paper to the *Botanical Gazette* (June) upon the Collection and preservation of the Myxomycetes. It will repay every collector to give the paper a careful reading.——The Report on Forestry, Vol. iv, 1884, prepared by N. H. Egleston and published by the Department of Agriculture, is exceedingly disappointing. The contrast between this volume and that of about the same size, lately issued by Professor Sargent, on "The Woods of the United States," is characteristic. It seems to be very difficult to get first-class work done in some of the government departments. Why cannot our officials learn that when they want a scientific problem investigated they must appoint *scientific* men to do the work.——

As an earnest of better methods we are glad to note the appointment of E. L. Scribner as assistant botanist to the Department of Agriculture. He has been assigned the care of the cryptogamic portion of the herbarium, and will devote most of his time to the study of the parasitic fungi, especially those which affect injuriously the field and garden crops.—— The April number of *Nuovo Giornale Botanico Italiano* contains an exhaustive paper, by Danielli, upon the structure of *Agave americana*. It is illustrated by seven large plates containing eighty-one figures.

ENTOMOLOGY.

THE BLACK, WHEAT-STALK ISOSOMA (ISOSOMA NIGRUM, n. sp.)—Early last autumn I received from Mr. Wm. Deyo, of Denton, Wayne county, Michigan, specimens of wheat straw which contained from five to sixteen larvæ of a four-winged (hymenopterous) fly. The portion attacked was usually near a joint, but might be anywhere along the internode, and was found above every joint, though very rarely above the highest one. The immediate region of attack was creased and deformed (Fig. 1), though not swollen, and was very hard, so that to cut it, except with a very sharp knife, was difficult. At this portion of the stalk, which was usually from three centimeters (one and a-fifth inch) to five centimeters (two inches) long, the straw was not hollow but solid throughout. By cutting into this deformed straw the yellowish-white larvæ were found in oval cells. These cells were about four millimeters (.16 of an inch) long. I published an account of this fact in several papers of Michigan and other States (see *Country Gentleman*, Vol. 49, p. 817) asking for further information. In response to these inquiries I received several communications from Wayne and Washtenaw counties, Michigan, in both of which the insect worked extensively.

FIG. 1.—Black dots show exit of fly.

So far as I can learn the insect has never been noticed before; and as the hardened pieces of straw break off in thrashing and come out of the machine with the grain, their presence could hardly escape attention. Mr. I. S. Vandervort, of Ypsilanti, Michigan, to whom I am indebted for many specimens, says the attack was quite general in Washtenaw county, and that the short straws in the grain had been noticed and commented upon by many farmers who had not even mistrusted that insects had anything to do with it. At our Farmers' Institute held at Plymouth, in January, I found hardly a farmer who had not been vexed by the small pieces of straw, yet not one had discovered the cause.

In the *Country Gentleman*, Vol. 49, p. 857, Professor J. A. Lintner refers to similar attacks of wheat in New York, and says the cause is the same species that has done so much damage in

Illinois and south—*Isosoma tritici*; yet from the brief description I think it far more likely that *Isosoma nigrum* is the insect which is doing the damage in New York. The farmers in Wayne and Washtenaw counties are not sure that the damage was very great, but all reported the wheat yield below their expectations. Professor Lintner estimated the loss in New York to be from sixty to seventy-five per cent in such stalks as were attacked.

Isosoma nigrum n. sp.—Female (Fig. 2): Length of body 4.4^{mm}; expanse of wing 6.5^{mm}; greatest width of anterior wing 1.1^{mm}; antennæ sub-clavate, somewhat pilose, reach to middle of thorax. The scape is a little less hairy, and as long as the two following joints together. The fourth, fifth, sixth and seventh joints sub-equal. Ten of the eleven joints are plainly marked when viewed with a hand-glass. Head and thorax black, dull, punctate, rugose and covered, though not densely, with fine gray hairs. Abdomen shining black, polished sparsely hairy; as long as head

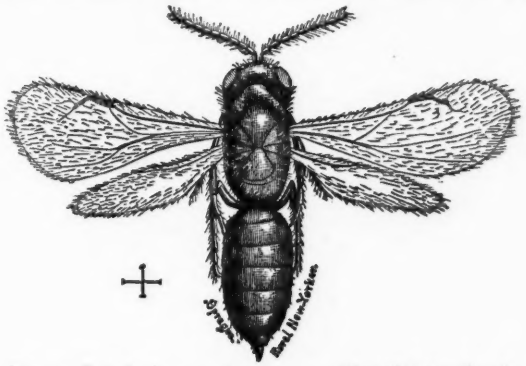


FIG. 2.—Female *Isosoma nigrum* n. sp. Magnified ten diam.)

and thorax together and larger than thorax. The antennæ, including scape, mouth-parts, head, abdomen and thorax, except a small, rounded, light-colored spot on the pronotum just back of the eyes, are pitchy black. The trochanters, femora, middle and posterior tibiæ black. The anterior tibiæ, tibio-femoral joints, one-third of distal end of anterior femora, and tarsi are yellowish-brown. In some cases the distal ends of the tarsi are dusky. The legs are thickly pilose. The wing-veins are honey-yellow and extend to outer third of wing. Sub-marginal vein three times as long as marginal; marginal nearly twice as long as post-marginal; post-marginal and stigmal sub-equal. Described from more than 100 specimens. Wings in all perfect. Variations very slight.

The eggs (Fig. 3) are white, 75 to 100 in number; 1^{mm} long, and each with a

FIG. 3.—The egg.

pedicel two and one-half times as long as the egg.

Male; Length of body 3^{mm}; expands 5.8^{mm}; greatest width of front wing 1.3^{mm}; antennæ sub-cylindrical, longer than in the female, with more and longer hairs; the last seven joints sub-equal. Thorax and abdomen as in the female, except that the pronotal spot is wanting or very obscure; the abdomen slightly peduncled, shorter and hardly larger than the thorax. Coloration of body and appendages same as in female. Venation similar to that of female. The wings in both sexes are margined with hairs, which are rather coarse along the marginal and post-mar-

ginal veins. The general surface of the wings show numerous short hairs. The males are nearly as numerous as the females, and all have perfect wings.

Larva: The larva (Fig. 4) is yellowish-white; length 4^{mm}: jaws dark, without teeth. The antennæ are short, one-jointed tubercles of the same color as the body. Very few hairs. Stigmata very obscure.

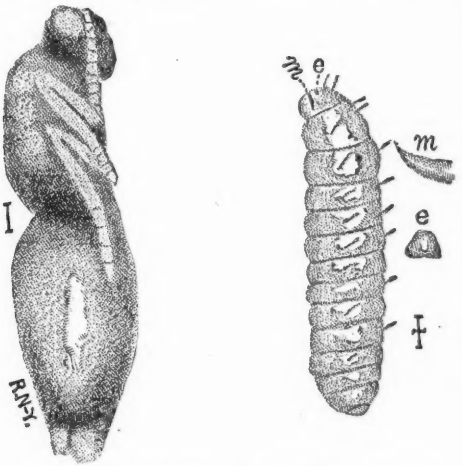


FIG. 4.—Larva and pupa. *m*, mandible; *e*, antennæ.

Pupa (Fig. 4): In autumn and winter white; in late spring black. Length 4.1^{mm}; male 3.2^{mm}. In autumn the wing pads are very indistinct, hardly visible, but in spring they are plainly marked.

This insect is very different from the *I. tritici* (Riley), (first described in the *Rural New-Yorker* of March 4, 1882), in being much larger, in its black scape in antennæ, black mesoscutum, black coxæ, light instead of yellow pronotal spot, the numerous males and the fact that all are winged. These work to the number of from five to fifteen at one place in wheat stems, instead of one or two, and the stalk solidifies. The larva has no teeth on its mandibles and only one joint to the tubercle-like antennæ. It differs from *I. grande* (Riley) but little in size; but in other respects the points of difference are much as above.

From the old joint-worm of Fitch (*I. hordei* Harris) it differs in being larger, in having a black scape to antenna, black mouth-parts, and in working in great numbers in a single straw, in causing the straw to solidify, in not forming a swelling and in working anywhere on the internodes of the straw.

From *I. elymi* (French) it differs in being much larger, and the legs are not so fully fuscous. *I. elymi* works in grass, which is probably true also of this species, yet they must be quite distinct, as shown by sizes.

Dr. C. V. Riley kindly informs me that he thinks this is *I. hordei.* He says he has specimens from Virginia, right where

the original types were found, some of which have a yellow scape, others a black one. He thinks this is Fitch's variety *tritici*. I at first thought this *hordei*, but the fact that Fitch makes no mention of any specimens with other than a yellow scape and yellow mouth-parts, and inasmuch as Dr. Harris and the late B. D. Walsh, with Fitch's descriptions before them, say all of Fitch's varieties are exactly alike except in coloration of legs, added to the fact that of the hundreds of specimens examined by me, not one showed any tendency to vary from black in scape and mouth-parts, while there was considerable variation in the coloration of the legs, led me to believe that my specimens were of a distinct species.

The fact, as Dr. Riley writes me, that so accurate a scientist as Dr. Harris does not speak of the yellow scape and mouth-parts would indicate that *nigrum* and *hordei* were identical.

Another entomologist, who has made quite an extensive study of these Isosoma, writes me that he inclines to the opinion that all our Isosoma are only varieties of one species modified by surrounding conditions.

It will take much observation to clear all this up. As species are only venerable varieties, which by age have been run into the mold of invariability, it really makes no great difference. Practically the matter remains the same in either case.

From what we know of related species, and from the fact that all the internodes (spaces between the joints) are attacked, or receive eggs, it is quite certain that the eggs are laid late in May and in June. By September the larvæ are matured. I found several pupæ in the cells of the straw on September 16. I found a few larvæ in January. It would seem, then, that a few of the insects pass the winter in the larval state. Specimens kept in a warm room all winter commenced to leave the cells in the wheat stalks, as mature insects, on March 22. At that date a male and female appeared. Each succeeding day ever since from two to eight have appeared. From straw kept in a cold room during the winter no flies have appeared until April 20. It is likely that in the common out-door temperature they would not come forth from the pupa state till May. This point can be easily settled in the field the coming season. This and the date and method of laying will have to await determination till the insects can be studied in the field the coming May. The method of oviposition is undoubtedly much like that of *I. grande* and *I. tritici*, as described by Mr. F. M. Webster (see Report Department of Agriculture, 1884, page 383), and Dr. C. V. Riley in the same volume, page 358.

If we may judge from the related insects, *Isosoma hordei* (see Fitch, 7th report, p. 162) or *Isosoma tritici* (see Forbes, 13th report, State Entomological Illinois, p. 30, and Riley, Report United States Department of Agriculture, 1881–2, p. 183) we

may be quite certain that the damage from this insect may become formidable. If, as I think, the insects referred to by Professor Lintner are of this species, then we have positive evidence that they lessen the yield of wheat very materially. Indeed, we can hardly believe that so many larvæ can draw from the juices of the stalk without doing it serious injury. The hardening of the stalk can but retard circulation of sap, and must interfere decidedly with the growth and development of the berry. Several farmers have told me that from appearances the yield of grain in their fields should have been much larger. They could not account for the diminished yield except by the presence of this insect, which was very common, as seen in the numerous hardened pieces of straw which came from the machine. It is therefore greatly to be feared that this new pest will become a serious enemy to successful wheat raising, especially as from a large number I have reared but a single parasite, which as yet is undetermined. Even if it becomes very destructive, it is more than probable that parasites will soon attack it, and that, like the joint-worm (*Isosoma hordei*), it will after a time become powerless to work very serious mischief.

The remedies for this evil are very apparent. As the insects are in the straw from the date of cutting till the following May, it becomes very apparent that by cutting the wheat high, in which case nearly all the insects will remain in the stubble, and then burning the latter, all these will be destroyed. In case there is much green vegetation, it would be better to cut the stubble low before burning. If short pieces of the straw are found in the grain, these should be cleaned out and burned. From experiments made in the laboratory, by burying the straws in sand, and the insects still coming out, I doubt if plowing under will prove a very thorough remedy. As these have good fully-developed wings, rotation of crops would not serve as well to protect against this insect as it would in case of *I. tritici* and *I. grande*.

The drawings were made from life by my special student in entomology, C. P. Gillett.—*Prof. A. J. Cook, Agricultural Coll., Lansing, Mich.*

Entomological News.—The Rev. J. A. Marshall publishes in the Transactions of the Entomological Society of London, issued April 30, Part I (280 pages) of a detailed monograph of British Braconidæ. The generic and specific characters are given in full, and there are six excellent colored plates. It will prove very useful for reference in this country.——Part III of Rev. A. E. Eaton's elaborate monograph of recent Ephemeridæ is at hand, and is accompanied by Plates 46–63, containing figures of very great interest, particularly Pl. 52, representing the nymph sloügh of *Bætisca obesa*, the aberrant and curious American form.——Bulletin 5 of the Bureau of Entomology, U. S. Department of

Agriculture, consist of descriptions of North American Chalcididæ from the collections of the U. S. Department of Agriculture and of Dr. C. V. Riley, with biological notes, together with a list of the described North American species of the family, by L. O. Howard. This paper will be followed by others, and will prove of great service to entomologists.——It appears from the observations of C. Aurivillius, reported in the *Entomologists' Monthly Magazine* for May, that *Œneis bore*, an arctic butterfly, requires two or more summers to complete its transformations; also that humble bees probably require more than one summer to mature.——At the meeting of the Entomological Society of London, held April 1st, Mr. R. M. Christy exhibited a drawing of the larvæ of the local form of *Platysamia columbia*, known as Nokomis; he had found the larva in Canada feeding on *Elæagnus argentea*, the peculiar silvery appearance of which was strikingly in accord with the color of the larva, which latter was probably protected thereby.——At a sale of beetles in London a pair of *Goliathus giganteus* realized £10 10s. 6d., and a pair of *G. albosignatus* £7 10s.; a pair of *Rhætus westwoodii* sold for £8, and a pair of *Rhætulus crenatus* sold for £2 10s.

ZOOLOGY.

Sense of Color and of Brightness in Animals.—J. Graber has investigated the sense of color and of illumination in animals. To decide whether animals had a sense of light or of color he placed them in a box so arranged that qualitative and quantitative rays fell on one or other of its two divisions, which communicated with one another. Five mammals, seven birds, two reptiles, three amphibians, two fishes, three mollusca, twenty-seven insects, two spiders, and two worms were experimented with. It was found that the sense of color as well as the power of perceiving light was much more widely distributed among animals than has been generally supposed. The variations in the sense of color in various animals are very great, but a much greater number of observations must be made before a definite solution of the problem can be obtained.—*Journal of the Royal Microscopical Society, February, 1885.*

Artificial Division of Infusoria.—Mr. Crisp at a late meeting of the Royal Microscopical Society called attention to some very interesting experiments by Dr. Nussbaum and Dr. Gruber on the artificial division of Infusoria. Dr. Nussbaum divided an Oxytricha into two halves, either longitudinally or transversely, and found the edges at the point of division were soon surrounded with new cilia. Notwithstanding that sometimes some of the body substance, or even a nucleus, was lost during the operation, the two halves became normal animals, with four nuclei and the characteristic ciliary apparatus. The head portion formed a new

hinder part, and the right half a new leg, The complete organisms thus formed again developed by spontaneous division. Simultaneously with Herr Nussbaum's experiments Dr. A. Gruber artificially divided *Stentor cæruleus* with the same results. If the divided parts of a Stentor were not completely separated they almost tore themselves apart, sometimes by rotating in opposite directions. If the cut was not very deep, monstrous forms might be produced, as, for instance, with two complete anterior or two posterior portions.—*English Mechanic.*

Organisms in Ice.—Professor Leidy relates that he had placed in his hands for examination, a vial of water obtained from melting ice which is used for cooling drinking water. From time to time, among some sediment taken from a water-cooler, his informant had observed what he supposed to be living worms, which he suspected were introduced with the water into the cooler, and not with the ice. Upon melting some of the ice alone, the worms were still observed, and the water submitted for examination was some that was thus obtained. Professor Leidy was surprised to find a number of worms among some flocculent sediment, mainly consisting of vegetal hairs and other débris. Besides the worms, there were also immature Anguillulæ, and a number of *Rotifer vulgaris*, all living. It would appear that these animals had all been contained in the ice, and had been liberated on melting. It was an unexpected source of contamination of drinking-water, that Professor Leidy had previously supposed to be improbable.

The worms were probably an undescribed species of Lumbriculus. Several dead worms swarmed in the interior with large, ovate, beaked, ciliated infusorians, measuring from 0.05 to 0.06^{mm} long by 0.04 to 0.48^{mm} broad.—*Journal of the Royal Microscopical Society, February, 1885.*

A Fresh-water Sponge from Mexico.—

Myenia mexicana, n. sp.—Sponge (as seen from an alcoholic preparation) green, minute, encrusting Lemna and other water plants.

Gemmulæ spherical, surrounded by a close series of berotulate spicules, embedded in a granular crust.

Skeleton spicules long slender, gradually pointed, smooth or very minutely microspined.

Dermal spicules wanting.

Berotulate spicules pertaining to the gemmules in length about three times the diameter of the rotules; shafts nearly cylindrical, sometimes more slender near the middle; irregularly spined; spines long acute. Rotules flat, deeply notched, rays irregular, acute.

This species, collected by Professor E. D. Cope in Lake Xochimilco, about seventeen miles south of the City of Mexico, differs from the familiar *M. fluviatilis* chiefly in the far greater length of the shafts of the berotulate spicules. It is further interesting as being only the second species of fresh-water sponge to reach the hands of specialists from that region of N. America. These particular specimens were probably collected in an immature condi-

tion, as suggested by the abundance of sarcode and the scarcity of gemmulæ or statoblasts; the single small group of these organisms alone rewarding a careful search through the whole mass of material sufficed to fix its generic position.—*Edward Potts.*

A Hermaphroditic Crab.—While conducting an exercise in zoölogy a short time ago using the common crab (*Callinectes hastatus*) I noticed one specimen having an abdomen intermediate in form between that of the normal male and female specimens. I at once inferred that it might be a case of hermaphroditism, which I think it is. The abdomen is triangular and except the terminal portion or telson is devoid of joints; the joints of the normal female abdomen being represented by indistinct lines. The abdomen was firmly imbedded in the plastron, it being evidently not within the animal's power to "open" it. The abdominal appendages resemble in general those of the female, although much more attenuated and having an undeveloped appearance. The fifth pair of pereiopods lack the reproductive orifice in the basal joint found in the male; nor is the first pair of pleopods modified into copulating organs. The two little hooks fastening the abdomen into its groove are present; while there are only impressions representing the opening through the female plastrons for the expulsion of the eggs. When examined the internal organs were not in condition for a minute examination, still it is evident that neither male nor female organs were normally developed, as these organs were distinct in other specimens in similar condition, while they could not be found in this one.—*A. L. Ewing, New York, June 29, 1885.*

Discovery of Blind Fishes in California.—At Santa Clara College in the San José valley is a flowing artesian well 170 feet deep, from which are discharged sightless fishes, from one to two inches long. I shall make arrangements to send specimens of these to Professor Baird, United States Fish Commissioner, who informs me that he has eighteen varieties or species of blind fishes from Eastern artesian wells; none have been secured from this coast.—*J. D. Caton.*

The Mule Deer in Domestication.—I find here three specimens of *Cervus macrotis* var. *californicus* in domestication, which have given me an opportunity of observing them not hitherto enjoyed. This variety of the mule deer I first discovered at Santa Barbara in 1875 and spent nearly a week in the mountains and procured specimens for mounting, which I sent to the Smithsonian Institution, and I first described them in The Antelope and Deer of America, p. 95. While they are a true Macrotis, the variety is very distinct, the enormous ear which induced Lewis and Clark, who first discovered them, to call them the mule deer is common to both varieties, but the ear on this new variety I now find is not

so uniform in size as in the Eastern or mountain variety. Of the three specimens now under observation, one, a male, one year old, has the largest and coarsest ear I ever saw on one of the species of that age, being eight inches in length; while the pair in the adjoining paddock, belonging to Mr. Palmer, are two years old, have ears seven inches in length, which are smaller than the average of the species, though still larger than those of *Cervus columbianus*, which has the next largest ear for the size of the animal of any of the American deer. In color, too, they are more variable than the mountain variety. The yearling specimen above described, belonging to Mr. Simmons, is of the dark gray color, so uniform in the mountain variety, from which no one would think of distinguishing it, but for the peculiar coloring of the tail, which is after all the most distinguishing feature of this variety from the other, and in these specimens is more pronounced than on the specimens procured at Santa Barbara.

In the mountain variety the entire tail is a yellowish white, except a jet black tuft at the end, while on the California variety there is a dark line extending on the top or upper side all of the way down to the terminal black tuft. In the Santa Barbara specimens this dark line down the tail was of the color of the coat above, while on these the dark line is black like the terminal tuft—at least this is the case with the yearling buck and the two year old doe, which are evidently of normal color. The two-year-old buck, however, is of a much brighter color than any other Macrotis, which I have seen. While it is not a white deer it approaches the white, the ears being the darkest, or nearest the normal color of any part of the animal. On the tail of this deer the dark line is much obliterated, but not entirely so.

That which distinguishes *C. macrotis* from all other deer is that the under side of the tail is naked to about the same extent as the horse's tail. This peculiar feature is observed on all of the specimens of both varieties to the same extent.

The habitat of *C. macrotis* is from the Missouri river to the Pacific ocean and from British Columbia to Mexico. So far as I have present information, this California variety occupies a region south of San Francisco and not extending east of the State line. I lack evidence to show that it is not confined to still narrower limits.—*J. D. Caton.*

THE GREEK AND THE MODERN FOOT.—It is well known that the Greeks represent the second toe as longer than the great toe in their statues, while in the modern European foot, the great toe is generally the longer. In this respect, as stated by Albrecht, the Greek foot is more quadrumanous than the modern. The antique statues generally represent the great toe as standing further from the second than is seen in the moderns. This might also be a quadrumanous character according to Schaffhausen, but Albrecht

thinks it is only the result of the wearing of the sandal strap. The reduction of the smaller toe Albrecht is disposed to ascribe to the wearing of shoes.

Zoological News.—*Cœlenterates.*—Mr. S. J. Hickson (Trans. of the Roy. Soc., 1883) describes the ciliated groove which exists upon the ventral side of the stomodæum in many of the Alcyonarians. This groove, or "siphonoglyphe," which keeps up the circulation of water whilst the animals are retracted, is not present in the three genera of simple Alcyonaria, assumes more important proportions in these colonial forms (as Alcyonium, Spongodes, etc.), which have long body-cavities, is present in one of the two forms (the siphonozoöids) of the dimorphic Alcyonaria (Pennatulidæ), and is absent in the Gorgonidæ, in which the solid axis occupies a greater bulk than the sarcosoma. The author works these facts into a new classification of the order, which he divides into (1) the Proto-alcyonaria, (2) the Stolonifera (Tubipora, Clavularia, Sarcodictyon, etc., (3) the Pennatulida, (4) the Gorgonidæ, containing the Primnoaceæ, Gorgonaceæ, and other families without a siphonoglyph, (5) the remaining Alcyonarians (Cœlogorgia, Paragorgia, etc., with a siphonoglyph.

Echinoderms. — In the Philosophical Transactions of the Royal Society (1884), Mr. Herbert Carpenter describes a new crinoid from the Southern sea. This species, *Thaumatocrinus renovatus*, presents two characters found in no other Neocrinoid, but present in some of the older Palæocrinoids. These are the persistence of the oral plates of the larva in the adult, and the separation of the radials by interradial plates. There is also a closed ring of basals on the exterior of the calyx, and a jointed arm-like appendage on the interradial of the anal side. The example was dredged at a depth of 1800 fathoms. Like Eudiocrinus, it has but five arms, and is very small.

Crustacea.—Recent notes upon crustacea, by E. J. Miers, published in the Proc. Zoöl. Soc., London, include a list of thirteen decapods from the Mauritius, five of them not before recorded, from that island, and one, *Callianassa martensii* Myer, believed to be new to science.

Mr. F. Day (Proc. Zoöl. Soc., 1884) exhibited the skin and skeleton of a female *Acanthias vulgaris*, the whole of the flesh of which had been eaten out by the Isopod, *Conilera cylindracea.* About twenty examples of this crustacean, some of them one and a quarter inches long, were taken from the remains. Mr. Dunn, of Megavissey, who sent the specimen, remarked that in the summer months these lice are very abundant fifteen to twenty miles from land, generally on soft and sandy bottoms. He had taken one hundred dog-fish at once in a mullet-net, but nearly every one was found to have been eaten in a like manner. They devour a fish in a few hours, and hunt in large shoals. Congers and other

fish leave when they appear, but occasionally a shoal of bream will come and eat them up.

Fishes.—In the Proceedings of the National Museum Professor Jordan published a paper which includes notes by Mr. S. B. Meek on the types of North American freshwater fishes, found in the museum of the Philadelphia Academy. The latter display some deficiency of due caution, to say nothing of amenity, in dealing with the subject. Confidence in some positive identifications, and also some discoveries of error, will be much weakened by a knowledge of the fact that some of the specimens bear unreliable labels. These were placed upon them by a person employed for the purpose by the "authorities" of the Academy, who was totally ignorant of ichthyology, and not very well acquainted with the English or classical languages. At the time of the taking charge of the collection by this person, many of the specimens had not been distributed into separate bottles, and numerous labels were contained in each bottle. Of course they could not be attached to the correct specimens by the curator in question. Mr. Meek finds that the characters of one of the species were derived from "the shrivelled condition" of the type specimen. It is difficult to imagine where Mr. Meek obtained this information, as the specimen was in a perfectly fresh state when described several years before Mr. Meek was known as a student of the subject.

Batrachians.—Mr. G. A. Boulenger (Proc. Zoöl. Soc., 1884) describes eight new species of Batrachia from the Solomon islands, including the new genus Ceratobrachus.

The greater part of England is free from the croaking of the frog, but a croaking edible frog has for some time been found at several spots in Cambridgeshire and Norfolk. This form, usually thought to have been introduced from France and Belgium, has been shown by M^{r}. G. A. Boulenger to be the Italian form, *Rana esculenta lessonæ*. Forty years ago the typical *R. esculenta* was turned out in great numbers in Norfolk, and examples have recently been taken. Though, when the whole Palæarctic range is considered, it is difficult to keep these forms apart, so far as regards England they are quite distinct. Indeed, if the genus Pyxicephalus of many authors is admitted, the form *lessonæ* would fall into it. There is no authentic record of the introduction of the Italian variety, but it was possibly done by the monks.

Birds.—Capt. G. E. Shelley (Proc. Zoöl. Soc., 1884) describes three new species of birds from the Kilimanjaro district, East Africa. These are *Muscicapa johnstoni*, *Nectarinia kilimensis*, and *Pratincola axillaris*. *Nectarinia reichenowi* (*Drepanorhynchus reichenour* Fischer) is described and figured. The specimens came from heights of 5000 to 8000 feet.

Two examples of the American kestrel (*Falco sparverius*) are reported to have been seen in May, 1883, at Helmsley, in Northeast Yorkshire, England, and the female was shot.

A new Laniarius, *L. lagdeni*, from Ashantee, has been described by Mr. R. B. Sharpe.

Mammals.—An examination of the uterus of the four-horned antelope, made by W. F. R. Welden, showed that it is divided into two compartments by a partition extending one inch into a passage internal to the os uterus. The Fallopian tubes are very small. The placenta is exactly intermediate between the completely diffuse one of Moschus, and the complexly cotyledonary apparatus of the sheep, for example, on the other. Each fœtus has twenty-two to thirty cotyledons.

The lesser koodoo (*Strepsiceros imberbis*) differs from *S. kudu*, not only in its smaller size, but in the absence of the fringe of long hair down the neck in front, and in the much more compressed spiral of the curvature of the horns. Mr. Holmwood, British Consul at Zanzibar, states that it occurs on the Juba river, exactly under the equator, in groups of three or four. A stuffed example from Somali land is in the British Museum.

EMBRYOLOGY.[1]

On the availability of embryological characters in the classification of the Chordata.—The development of a median axial cord, differing essentially from cartilage, and which seems to arise from a strand of cells constricted off longitudinally from the upper side of the hypoblast and having the same or almost the same extension anteriorly and posteriorly as the nervous cord, at once distinguishes all embryo and primitive Chordata from all other types, and justifies the substitution of the latter term for the older name, Vertebrata. It is obvious that the term Chordata is a more applicable one for the reason that there are forms which never develop vertebræ, while there are none in this series which fail to develop a notochord at some stage, having the antero-posterior extension described above. The name Vertebrata, therefore, carries with it implications which are not justified by facts. Lankester insists for this reason that the term Vertebrata be abandoned, and that the word Chordata be substituted for the name of the phylum, so as to express a fundamental truth in scientific taxonomy.

It has been insisted that embryological data are not available for the purpose of discriminating classes, subclasses, etc., and, judging from the more or less unsatisfactory attempts made to arrange the Chordata on a purely embryological basis, this opinion has not been without foundation. The following notes are not so much intended to bring a new system to the notice of naturalists as to arrange some of the data of embryology in what seems to the writer a rational order. While it must be admitted that our knowledge is still imperfect in relation to the develop-

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

ment of certain considerable groups, every addition to that knowledge demonstrates that what has appeared to be exceptional or in violation of general principles, upon further investigation has really substantiated those principles. Inasmuch as the theory of evolution, as well as that of embryology, first considers the simplest phases of differentiation, the order in which the types should be successively considered will be an ascending one, in which we will pass from the least to the most differentiated modifications of the egg and embryo, without admitting, however, that the order of arrangement here adopted is indicative of the exact course which the evolution of the groups has taken. That is a problem which for obvious reasons no one will probably ever solve or succeed in stating with more than partial accuracy. The scheme which follows is therefore offered merely to show the arrangement which results when embryological characters alone are used, and will, the writer believes, serve at least to bring together the principal facts so as to display the direction along which specialization has progressed in the course of the evolution of the modes of development of the various chordated forms.

The Chordata present three well-marked modes of embryonic development consequent mainly upon the manner in which the germinal matter of the egg is related to the vitellus, and upon how much the latter takes part directly in the formation of the embryonic organs, and in what manner the blastula or blastophere is directly related to its environment in the course of its development and growth. The direct influence of conditions which induce modifications in a purely mechanical manner is very plainly illustrated in embryological development; in fact it may be shown that the highest type of development as displayed in the greatest complexity of the germ or embryo has grown out of a simpler condition developing under simpler environing conditions. It may thus be shown that *even the mode of development of the ovum has been modified through adaptation.*

I. The lowest and most unmodified expression of chordate development is that which I will call the Haplocyemate, as seen in the single type Branchiostoma. Here the embryonic axis develops directly from a double-walled gastrula formed by the invagination of one side of the blastula into the other half. The myotomes are developed from paired diverticula of the mesenteron, and the development is not modified in any way by the presence of a yolk-sack. This group embraces forms in which no part of the ectoblast is cast off when the embryo is set free, and in which there are no special respiratory saccular membranes developed in connection with any part of the blastula or blastodermic vesicle; no primitive streak.

Ovum with a zona radiata only, which becomes distended and tensely filled with water around the egg proper; no albuminous

envelope and no outer shell or additional membranous covering. Cleavage total and equal, as a result of which a blastula is directly developed. The invaginated half of the blastula leads directly to the formation of the intestine. No actinotrichia or embryonic fin-rays developed. These features seem to distinguish the Leptocardii, or Haplocyemate forms from the succeeding ones.

II. The second great subdivision of the Chordata I will call the Epicyemate subphylum. In this series the embryo never becomes bodily invaginated or so pushed into the blastodermic vesicle as to become invested by up-growing folds of the ectoblast, but remains attached to the yolk by a stalk or is sessile upon and external to the latter, which may or may not form an integral part of the intestine. This group also embraces forms in which no part of the ectoblast is cast off when the embryo is set free. There is no amnion nor any functional allantois developed. The vessels of the yolk-sack, when developed, are respiratory in function. The primitive streak is either comparatively short or wanting. This subdivision answers very nearly to the Ichthyopsida of authors.

1. The lowest division of the Epicyemate series may be called the Ichthyoidea, and brings the Amphibia and Marsipobranchii together. In them the ovum is provided with a zona radiata; there is no outer albuminous envelope; the zona is often elastic, and the cavity it encloses may increase with the progress of development, and may be covered externally with an adhesive or gelatinous investment. The cleavage is unequal; no true blastodisk is formed; the germinal and nutritive poles are, however, soon defined at opposite poles of the egg. Vitellus segmented into large spheres which enter into the formation of the inferior portion of the intestinal wall. Oviparous, or the ova are carried about by the parent in dermal pouches.

a. The first subseries of the Ichthyoidea is enterotrophous, that is, the yolk-cells in the embryo are in a ventral position, and extend along the whole of the middle and posterior part of the developing intestine. Amphibia.

b. The second subseries of the Ichthyoidea are opisthotrophous, that is to say, the yolk-cells while they enter into the formation of the ventral portion of the intestinal wall as in *a*, they are in a posterior position; the embryonic axis is formed from behind forwards, so as to appear as if it grew out from the posteriorly-placed mass of yolk-cells. Petromyzon.

Much may be said in favor of affiliating the marsipobranchs with the amphibians, but whether the development of Myxine will countenance the foregoing arrangement remains to be learned. It is, however, very certain that the general plan of development of the two preceding series approximates that of Branchiostoma far more closely than the more specialized development of the Ichthyes.

2. The highest major group in the Epicyemate subphylum I will call Ichthyes, as it is the only series in which true fin-rays are developed, and in all of the forms embraced by the term true embryonic fin-rays, or actinotrichia, may be found in the fin-folds of the embryo.

The ovum is provided with a zona radiata, but is entirely without or has only an inconsiderable albuminous envelope, rarely with loose granules of proteinaceous matter included between the vitellus and zona; no chalazæ; no calcareous shell, though sometimes there may be present in addition an outer tough, fibrous envelope (Elasmobranchs), or a canaliculated gelatinous (Perca), or a partially separate adhesive investment (Amiurus). The cleavage is partial, but a well-defined blastodisk is developed: the blastophere is formed by epiboly or growth over the vitellus. The vitelline matter is contained in the inferior pole of the blastophere, but never enters directly into the formation of a part of the intestinal wall.

a. The first subordinate group under Ichthyes is characterized by being ectotrophous, for the reason that the embryo is sessile for only a short time, as it soon becomes folded off from the yolk and raised upon a hollow umbilical stalk, so that the yolk eventually occupies an apparently extra-abdominal position, or rather it lies in a bulbous extension of the abdominal cavity. This series embraces the Selachians and Holocephali.

b. The second subdivision of the Ichthyes is equivalent to the Teleostomi of authors. These, as far as known, are cœlotrophous, that is to say, the embryo is sessile upon the yolk, and is never folded off so as to develop a stalk; the yolk is intra-abdominal and below the intestine and between the latter and the greatly distended somatopleure.

The Teleostei, Holostei and Chondrostei belong here, and it will be very surprising if any embryological characters are ever found which will separate the archaic Crossopterygians and Dipnoans from this series. For the characters of the latter we must, however, await the results of the researches of Mr. Caldwell.

III. The third subphylum of the Chordata is Endocyemate, that is, the embryo is more or less completely invaginated into the blastodermic vesicle at an early stage, in consequence apparently of its being confined in a contracted space, such as the uterine cavity or outer egg-membranes and shell, as a result of which are formed from the ectoblast, during the further growth of the embryo: (1) the amnion and its cavity, (2) the false amnion and its cavity; into the resulting space between these two membranes the allantois and umbilical vesicle are extended. The primitive streak is usually more or less prolonged behind the embryonic axis. This subphylum embraces forms in which a part only of the ectoblast enters permanently into the formation of the embryo, while a larger portion from which the false

amnion or the *Reichert'sche deckschicht*, Rauber, subzonal membrane, Turner, serous envelope, von Baer, and the true amnion, are formed, is cast off at birth or when incubation is completed. A highly vascular allantois is also developed in the majority of the species of this group, and, as a rule, takes the most important share in the respiratory functions of the embryo, and in the development of the fœtal part of the placenta whenever that organ is present.—*J. A. Ryder.* [*To be continued.*]

PHYSIOLOGY.[1]

PFLÜGER'S "AVALANCHE THEORY" OF NERVE-CONDUCTION.—M. Vulpian calls attention to the fact that in faradisation of various motor areas in the cerebral cortex of the dog, the effective strength of current which must be used varies definitely with the region stimulated. The minimal effective strength of current for the muscles of the face is less than that for the muscles of the fore-limb, and still less than for the muscles of the hind-limb. In general the strength of effective current must increase with the length of motor nerve tract. This result is readily explained if we consider that the nervous impulse started in the brain gradually diminishes in power as it passes along the motor nerve. But this assumption is in contradiction to the classic "avalanche theory" of Professor Pflüger, according to which the nerve impulse accumulates energy in its progress, so that a certain strength of stimulus applied to a motor nerve produces a stronger contraction the farther the place excited is removed from the muscle. It is this theory which Vulpian undertakes to test, and concludes with a denial of its adequacy.

In Vulpian's experiments dogs were used and so heavily chloralized as to paralyze the reflex powers of the spinal cord. He carefully isolated, without cutting, the external popliteal branch of the sciatic nerve and also the anterior tibial nerve. These nerves are in the dog of about the same thickness. Vulpian found that with a weak current strong flexion of the foot was brought about by stimulating the anterior crural, while no movement was produced when the popliteal branch was excited with the same current. He therefore concludes that the nervous impulse, far from gathering strength in its passage along a nerve, is used up in its progress and gradually diminishes in intensity.—*Comptes Rendus, Tome C, p. 1038.*

MOVEMENT OF THE RETINAL CONES UNDER THE INFLUENCE OF LIGHT.—But three kinds of physiological change have been observed in the retina as an effect of the action of light: 1. The electrical currents discovered by Holmgren; 2. The bleaching of the visual purple in the outer segments of the retinal rods; 3. The movement of the pigment in the outermost or epithelial

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

layer of the retina; both the latter phenomena were discovered by Boll. But Professor Engelmann, of Utrecht, adds another to the objective disturbances caused by light in the retina, namely, that of movement of the inner segment of the retinal cones. The inner segments of the cones become shorter under the influence of light and longer when the light is removed. The amount of this difference in length owing to illumination varies in different animals. The difference was most marked in the fish and frog. In a fish which was kept eight hours in the dark the inner cone segments, measuring from the *mem. lim. ext.* to the inner pole of the cone ellipsoid, had a length of about 50μ; after remaining several hours in diffuse daylight the length of the inner cone segments in the same animal was only about 5μ. In preparing the retina for observation the eye-ball was rapidly excised and plunged in 3.5 per cent nitric acid, or for several minutes was warmed to 70°–80° C. in 0.5 per cent salt solution.

A frog which has been kept in the dark shows maximal contraction of the cones after several minutes exposure to diffuse daylight. All parts of the visible spectrum produce the change in question, but the more refrangible rays have apparently most marked influence. It is apparently the inner cone segment itself which is directly affected by the stimulus. The movement of the cones and of the epithelial pigment seems to be under the control of the nervous system; for if an animal which has been kept long enough in the dark to bring about maximal lengthening of the cones and retreat of the pigment, be exposed to light so that only one eye is illuminated, the influence of the light is manifested by both retinas; but if the brain has been previously destroyed, the contraction of the cones and the moving inward of the pigment occur only in the eye which is directly exposed to light. We may, therefore, consider that the movements in question are reflex actions, and that the optic nerves contain *motor* fibers for the protoplasm of the cones and of the retinal epithelium. Engelmann declares also that light acting directly upon the skin of a frog whose head is kept in the dark, brings about the same retinal changes as does light falling directly upon the eyes.—*Pflüger's Archiv., Bd. 35, s. 498.*

PSYCHOLOGY.

Applied Metaphysics of Sex.—When ethics is reduced to a science it is a department of metaphysics. Its application to practice will be "morals." One of its data is the law of Confucius, that man should not do to another what he would not wish that another should do to himself. The converse of this proposition, as uttered by Christ, imposes a greater proportion of active measures. Both are relatively carried into practice to the degree in which the wishes of men are subordinated to their intelligence.

They embody the regulating principle for what are called the purely selfish or appetent qualities of the mind.

For the sympathetic qualities, whose selfishness is diffusive, and includes good will to one or more other persons, somewhat different data are necessary. The leading interest in this department is that of sex. The metaphysical condition of love, is a pleasurable hyperæsthesia connected with the mental or actual image of a person of the other sex. The province of ethics, and its application in law in this matter, is the security of the persons interested in this property, mental and physical. If this hyperæsthetic state were always prominent, because based on sufficient grounds, there would be no necessity for laws in the matter, any more than there is necessity for laws to compel people to retain a fortune or a sound stomach. But in fact this hyperæsthesia sometimes has no sufficient *raison d'être* in the character of its object. Sometimes the mental powers are unable to retain it long at a time; and some persons have little or no capacity for its metaphysical form. For the protection of people who are highly developed in this respect, laws have been enacted which punish infringements on their rights of property.

It is, however, evident that these laws may and do work to the injury of the people they are designed to protect. This is the case, *e. g.*, when persons of great affectional capacity are bound to those of little or no capacity. It is the case where a person of fine general organization is bound to a person of coarse and brutal organization. It is also true where persons of high development of sex affection are otherwise of totally diverse and antagonistic constitutions. Hence divorce laws for the separation of such ill-mated persons have been enacted, and their utility cannot be denied.

It is not divorce laws which are to be feared, but something which lies deeper; that is the weakening of the metaphysical sex interest, and its subordination to lower or less important interests. Any system of religion, state policy, or social custom, which tends to weaken the force and freedom of conjugal affection, is probably the greatest curse that can befall a country. A principal reason why this is true is because the metaphysical sex interest constitutes one of the most important stimuli to exertion, and therefore to development.

One of the causes which destroy this primal source of energy and happiness in life, is the prevalence of the idea that the sentiment of love has no real existence; that it is a deception, or at best a sensation of short duration. Such a view can only be demonstrated in the lives of people in whom the instinct and sentiment are weak or wanting. For such it is doubtless true; but the blind man cannot prove that all men are like himself; he is debarred by natural incapacity. But well-constituted persons frequently adopt the idea on various grounds. The reason why

such well-constituted persons may entertain such a view, is the failure of the individual to realize his or her ideal in this direction.

One principal cause of failure to realize the ideal conjugal state, is constitutional weakness of the sentiment. This may be mental alone, or it may be physical. If the "grand passion" is to exist, its physical basis must not be destroyed. When the affection is properly developed, it leads to a subordination of many things which would conflict with it. Truth and honor become the basis of permanent confidence between the contracting parties, and everything that is disagreeable to the object of affection will be abandoned, so far as consistent with the necessities of existence, and of honorable conduct to others. When the sex sentiment is not well developed, these ameliorations will not take place. One or both persons will have ground of complaint, and if in the balance of motives either finds it more pleasant to him or herself to be disagreeable to their matrimonial partner than to be agreeable, the term of such persons' association is likely to come to a speedy end. In the case of personal bearing the male sex is often the sinner, since the more sensitive nature of the woman requires more consideration than the more indifferent constitution of the man. In the matter of rationality of conduct and opinions, the female more frequently errs.

One of the causes which tend to weaken the sex sentiment, is want of intellectual sympathy. This is at present a more or less necessary evil, but the development of the intellect is progressing, and will bear rich fruit in the field of the affections. Perhaps the most important factor in this progress, is the education of women. Their general want of interest in and knowledge of the thoughts and interests of man, is a fruitful source of the indifference with which devotion is too often rewarded; and it is impossible that it should be otherwise. Women of feminine type, with developed intelligence, have never failed of response from the other sex.

The metaphysical history of love is one of development, like that of any other mental faculty. Women display a greater capacity in this respect than men, for while many of them are as incapable in love as in reason, they much oftener rise to a high development of affectional activity and power than does the otherwise stronger sex. As to the application to practical life, the principle to be kept in view is this: the highly developed must be protected from the badly developed, both in and out of matrimony. As development of the mind in any faculty is a slow process, for a long time law will have to divide its sanctions, so as to encourage fidelity on the one hand, and on the other to facilitate the separation of incongruous partners. And that is what it is now doing in some countries with generally good results. Where divorce laws are properly framed and executed, if any social evils exist, they are due to defects in people them-

selves, and cannot be overcome by enactment. But in many countries the laws are such as to encourage and increase social evils, if not to produce them.

It is satisfactory to know that nature is necessarily more conservative in this field than in any other, so that pessimism has little ground for assurance. The incapable and the feeble in love have little part in the increase of the race. The irregular, excessive, or abnormal development of the passions have still less chance of propagation. The only cause for regret is the apparent inability of the best intellect to reproduce itself in any abundance. The future of applied science may bring us the remedy for this also.—*E. D. Cope.*

Tenacity and Ferocity in the Raccoon.—Happening lately to pass around the shores of a neighboring pond in my rambles, I noticed a crowd of boys gazing excitedly at one of their companions who had mounted a large tree overhanging the water, and was "shinning" his way toward the top of it. Inquiry revealed the cause to be a half-grown raccoon, which had taken up its quarters there for the day, seeming much disposed to stay where it was, despite the efforts of the youth to dislodge it; and he, having exhausted every method of persuasion suggested by his fellows, reluctantly descended to the ground, and a bombardment of stones then began which, though often well directed, did not budge young Procyon one inch from his comfortable position.

One of the spectators then produced a revolver and two rounds were fired by the "best shots" in the crowd, six bullets of the fourteen taking effect in its body. Terrible as these wounds were afterward found to be, the animal "held the fort" (so to speak) with dogged tenacity, its only efforts being confined to clinging to its chosen position in a fork of the tree. Seeing this, one of the boys started off and in a few minutes returned armed with a rifle. The second shot from this struck one of its fore-feet, passing directly through the ball of it. This wound, trivial when compared with the others, so maddened the poor beast that it tried hard to change its position, but its hindquarters being paralyzed it was unable to accomplish that feat, so in sheer desperation it began to rend the useless member with its teeth, savagely tearing it to pieces and dropping them to the ground. Another sure-flying bullet now sped on its merciful errand, and, struggling fiercely with death, the raccoon relaxed its grasp till one paralyzed foot alone sufficed to support its swinging body beyond the eager reach of its tormentors. And there it hung on, till in its dying efforts to regain the former position, it fell fifty feet to the ground with enough life remaining to justify considerable commotion among the boys while administering the *coup-de-grace.*

This instance brings to mind another which happened during the winter of 1879–80. Whilst a scholar at Westtown, Chester

county, Pa., I found, during one of my excursions along Chester creek, a half-grown "coon," which had snugly tucked itself up in the forks of a dead willow that stood on the opposite bank of the stream from me. It had its back to me, and desirous not to spoil the valuable pelt, I drew off some twenty yards and sent a heavy charge of shot into its body;—such at least was my intent, but, judging of results, I did not accomplish it. Beyond a violent tw tching of the skin as if to rid itself of a fly or other insect pest, there was no counter demonstration on the coon's part. My next fusilade was tendered from the creek bank, the long barrel of my weapon reaching within fifteen feet of the animal. At touch of trigger the results were tremendous, and after taking sufficient time to recover lost ground and senses, I realized that the concussion had worked both ways, and the coon, thoroughly aroused from its day-dream, was now floundering about, growling and gurgling in the depths of the creek. Having spent nearly a minute in that manner, it rose to the surface and divided its efforts there between reaching the bank and tearing the wounds in its body with teeth and claws, evincing a most desperate fury in every action. After continuing this long enough to have drowned the liveliest of cats, it reached the opposite shore, and instead of climbing upon it, the maddened creature disappeared *beneath* it, where a strong eddy of the waters washed and swirled under the overhanging banks and tree-roots. This suicidal manœuvre seemed so deliberate and intentional that hope of securing my game was well nigh gone from me ere it again emerged growling and gnashing its teeth as if enraged that it had not found death by other hands than mine.

Becoming fully sated with such an exhibition of brute ferocity and self-inflicted sufferings, I crossed the creek and succeeded, after a ten minutes' skirmish, in reducing it to perfect harmlessness without other disaster than several desperate nips on the toes of my boots, one of which was received after I had supposed the animal was dead.

I refrain from entering into detail of this closing scene further than to remark that it so impressed me with the fiendish vitality of a wounded raccoon, that hereafter similar encounters will be carefully avoided.—*S. N. Rhoads, Haddonfield, N. J.*

Likes and Dislikes of a Deer.—Mr. Simmons, who owns the yearling deer which I have mentioned in my article on Macrotis, informs me that he allows the barnyard fowls to share the grain fed to him without the least manifestation of hostility or displeasure, except as to a cock belonging to a neighbor. Whenever this bird flies into the paddock to pay a neighborly visit, the deer "goes for" him at once and puts him out with manifestations of anger or repugnance.—*J. D. Caton.*

ANTHROPOLOGY.[1]

BURNT CLAY IN THE MOUNDS.—The earliest travelers among the Indians mention mounds with buildings on the top of them covered with earth. In the mounds which I have examined, wherever burnt clay has been found more or less ashes occur underneath, and the impress of grass, sticks, cane or poles plainly reveals itself in the burnt clay. These vegetable substances were needed to support the earthen roof of the dwelling.

The dwellings of some modern Indians are built of poles, sticks and grass, covered thickly with mud. Upon the death of any of the inmates the house is burned down, and the framework consuming partly bakes the clay and leaves its impress therein. The Pimos and Maricopas of the Gila river, with all of the Indians of the Colorado river, build winter and summer dwellings. The former are hemispherical and mud-covered, the latter is an open mud-covered shed. When these are burned down at death, the clay is baked and appears just like that dug from many mounds.

In many of the modern houses the earth is dug out in the center for a foot or more; this points to the reason for the pits found in the middle of mounds. Charred posts are found in mounds, the same phenomenon presents itself whenever a summer shed is consumed.

In examining the celebrated ruins of adobe and stone houses in Arizona, it is found that they were destroyed by fire, burnt clay with impressions of sticks and poles being found in them.

The examination of some mounds demonstrates the existence of buildings without clay covering. Now I have lately visited several Indian tribes who live in the hot season under sheds covered with thatch, with merely earth enough above to keep the twigs from blowing away. Now the burning down of such a shelter would leave only ashes and charcoal.

Again, both houses are on the outside the receptacle of everything which the Indians wish to keep out of harm's way, baskets, pottery, wattled granaries for corn, mezquit, &c. Now in some mounds I have found the pottery and other relics so curiously located as to leave little doubt in my mind of the burning of such a structure as I have just described.

The modern hut builder does not cover his consumed dwelling with a mound because the new arts taught by the white man and his new environment have taken away all necessity. Furthermore the argument that the superior arts of the former Indians were associated with better houses for the artists is false. The finest works of modern art are produced in places no more elegant than the Pimo's summer shed.—*Edward Palmer.*

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

MORTALITY IN WASHINGTON.—Dr. B. G. Poole, of the Health office in Washington, has compiled a table of mortality by months, from 1875 to 1885, eleven years. This table not only exhibits the death rate of the months, but shows the disparity between the whites and the negroids. In comparing the results it should be borne in mind that the white population is about double that of the negroids:

	White.	*Negroids.*
January	192	163
February	177	180
March	207	184
April	178	170
May	166	157
June	212	206
July	240	227
August	199	198
September	177	174
October	176	158
November	164	143
December	177	150

The lines run nearly parallel, the negroid death being always nearly twice that of the white. In February the negroid death actually exceeds the white, January, March, November and December show a better condition for the negroids, the rate tending toward the correct proportions.

ANTHROPOLOGY AT JOHNS HOPKINS UNIVERSITY.—Under the editorial supervision of Mr. Herbert B. Adams is published monthly the "Johns Hopkins University Studies in Historical and Political Science." Several of these pamphlets, issued in 1884, have immediate bearing on anthropological science. "Institutional beginnings in a Western State," by Jesse Macy, A.B., No. 8 of the second series, appeared in July. This is a careful study in the early history of Iowa from meager documents and from the mouths of living witnesses. Nos. 8 and 9 of the second series, fifty-one pages, by William B. Weeden, A.M., is entitled "Indian money as a factor in New England civilization." The Indian wampum became established in colonial life as a medium of exchange, and contracts were made payable at will in wampum, beaver or silver. For more than a century this currency entered into the intercourse of Indian and colonist, affecting the whole development of industry and commerce. To trace this influence is the purpose of Mr. Weeden's paper. No. 11 is upon "Rudimentary society among boys," a pamphlet of fifty-six pages, by John Johnson, A.B. This is a charming study of the attempts made by the boys of the McDonough farm school, near Baltimore, to imitate their elders in managing their affairs. No. 4, third series, is by Richard T. Ely, Ph.D., and discusses "Re-

cent American socialism" in a paper of seventy-four pages. This monograph is a revised edition of an able series of articles published, in 1884, in the *Christian Union.*

THE DAVENPORT ELEPHANT PIPES.—Mr. Charles E. Putnam, of Davenport, Iowa, has published a pamphlet of thirty-eight pages as a vindication of the authenticity of the elephant pipes and inscribed tablets in the museum of the Davenport Academy of Natural Sciences, from the accusations of the Bureau of Ethnology of the Smithsonian Institution. Those who have known the history of Davenport Academy, its struggles and triumphs for the love of pure science, and the extreme caution of its leading members, regretted that anything should appear in a Government publication reflecting upon their veracity or honesty. Tablets are common enough, being made of slate and other material and worn to-day by the present Indians of British Columbia and Alaska. So long as they do not contain outlandish and unclassifiable inscriptions there is nothing mysterious about them. On the contrary, the elephant pipes are mysteries. When I try to put the cast which we possess at the museum with something else, there is nothing to put with it. Professor Henry once said to one of his assistants who discovered an unclassifiable specimen: "That seems to stand out so unsociably that we must call it an 'outstanding phenomenon,' and wait patiently until something else turns up to go with it." The last word that should fall from the lips of a brother naturalist is "fraud."

On the other hand, barring this indiscretion, Henshaw is just what Major Powell says about him. He is a very careful and skillful naturalist. We should hail with delight the accession of all such men to the ranks of archæology because they bring light from every side to bear upon our mysteries. It should not make a particle of difference to any of us whether a pipe is the figure of a crow or of a toucan, so long as we know just what it represents. We may rest assured that for a long time every mystery solved will be accompanied by two quite as inexplicable.

But, really, too much account is being made of the matter. Squier and Davis are not overthrown. Their manatee, toucan and paroquet may be shot down by the ornithologist, but these practical gentlemen did not care a fig about such creatures. They made the greatest archæological survey and collections ever attempted in America, and their volume will indeed be a "monument" to their memory and to the glory of its authors for all time.

The Davenport Academy is not annihilated. Even if our theory should turn out true and the elephant pipe should prove a tapir pipe, and we should learn that tapirs once lived in the Mississippi valley, this grand association would survive.

MICROSCOPY.[1]

SOME HISTOLOGICAL METHODS BY DR. C. S. MINOT.—*Müller's Fluid.*—In hardening in Müller's fluid it is important to keep the jar with specimens and fluid in a cold place, best near freezing, for three or four days. The delicate tissues are then much better preserved; probably the same is true of Erlicki's fluid. Using Müller's fluid at a high temperature is bad for epithelia.

Beale's Carmine.—

Carmine	1 gram.
Ammonia	3 c.c.
Pure glycerine	96 c.c.
Distilled water	96 c.c.
Alcohol, 95 per cent.	24 c.c.

Dissolve in the ammonia plus part of the water; add the rest of the water and allow to stand in an open dish in a warm place until the ammonia is nearly all driven off. Then add the alcohol and glycerine. For use, dilute with an equal part of glycerine, which must be thoroughly mixed in by stirring. Stain in an open dish, which, together with a second open dish containing acetic acid, is placed under a bell glass or in a closed box. The staining requires at least twenty-four hours, and much longer if the carmine is fresh. Beale's carmine improves with use, and what is left after being employed as directed should be filtered back into the original bottle.

From the carmine solution the sections are placed in water and washed *thoroughly*, after which they are placed for 1–3 minutes in hydrochloric acid diluted with water until it tastes about like sharp vinegar. They are finally again washed in water and are then ready to mount in the usual manner.

Employed in this way Beale's carmine is one of the most valuable of histological staining fluids, both for general use and also more especially for the central nervous system. If by any chance the sections are overstained, the superfluous color may be extracted by a *brief* sojourn in *very dilute* ammonia (one drop of strong ammonia to 5 c.c. of water is quite sufficient), this is to be followed by a rapid washing in water and an immediate transfer to dilute hydrochloric acid.

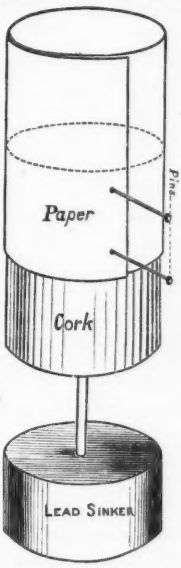
Eosine in Alcohol.—Best strength for staining is 0.0005. Dissolve one-half gramme eosine in one liter ninety-five per cent alcohol, or dissolve one gramme in 100 c.c. alcohol, and for use dilute one part of the stock solution with twenty parts alcohol. The alcoholic solution is far more convenient than the aqueous.

Imbedding in Celloidin.—The object after having been thoroughly dehydrated in alcohol is placed for twenty-four hours in a mixture of equal parts of strong alcohol and pure ether. If this mixture is kept long a little ether must be added from time to time.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.

Transfer to a thin solution of celloidin, and allow it to remain for from one to three days, according to the size of the object.

Imbed in a thicker solution of celloidin. This is best done as follows: A cylindrical cork of convenient diameter is selected; a strip of glazed paper wrapped round it tightly and fastened with a couple of pins as indicated in the figure. In the box thus formed the object is placed and the celloidin poured carefully over it. If necessary the object can be secured in any position by pins. Bubbles will rise from the cork and interfere with the imbedding; two precautions will essentially diminish this danger: 1. Pour in so much celloidin that it covers the object half an inch deep, giving an opportunity for the bubbles to rise above the tissue; 2. Before imbedding cover the end of the cork with a thin layer of celloidin, which is allowed to dry on completely. After the object is covered the cork is mounted on a lead sinker (see figure), and allowed to stand until a film has formed on the upper surface. It is then immersed in alcohol of 82–85 per cent (stronger alcohol attacks the celloidin) for one to three days. I have found it best to allow plenty of time for the hardening after imbedding.



The sections have to be cut under alcohol; we use Jung's microtome with his largest knife, placed so as to cut with as much of the blade as possible; if the edge is good, then the longer the draw the thinner the sections which can be made. While cutting the knife blade should have as much alcohol upon it as possible; to secure this we use the dripping apparatus described below. The sections should be removed from the knife with a fine brush, to avoid all risk to the edge. For celloidin imbedding are needed:

1. Mixture of ether and alcohol, equal parts.
2. A thin solution of celloidin in (1). This should be syrupy but still flow easily.
3. A thick solution of celloidin in (1) of about the consistency of thick molasses.

The usual mistake is to have the solution too thick. Quantitative directions cannot be given because the celloidin varies in weight according as it is more or less dried.

Celloidin is a purified gun cotton, manufactured by E. Scherring in Berlin, Germany. It may be obtained in Boston of the Prang Educational Co., and of the Educational Supply Co., in ounce boxes, at $1.25. It is a most valuable and important addition to the resources of the histologist, as it enables him to make thin

sections of large objects; and in these sections all loose bits of tissue are kept *in situ* by the celloidin which does not interfere with the staining or mounting. If for any reason it is desired to remove the celloidin, a little ether and alcohol will dissolve it from the section almost immediately. For the study of loose parts, where the sections would otherwise fall to pieces or require difficult manipulations, such as the placenta or brain, celloidin may, I think, be safely said to surpass any other material hitherto employed.

For mounting sections with celloidin left on them I have found none of the methods hitherto recommended satisfactory. The essential oils I have tried either dissolve the celloidin like oil of cloves, or cause it to shrink and distort the section like oil of Bergamot. After trying various reagents, I have settled upon chloroform as the most convenient medium of transfer from alcohol to balsam. In using it care must be taken to place the section for half a minute in perfectly fresh alcohol, which is really 95-96 per cent; if this is done chloroform will clear it up almost immediately. When the section is in chloroform on the slide, the mounting must be expeditious, and the balsam added *while the chloroform is still covering the section.* If many sections are to be mounted, it is convenient to have a dish full of chloroform and large enough to permit plunging in the slide and placing the section on it, all under chloroform. The transfer, particularly of a large section, from the spatula to the slide, with chloroform, is often VERY difficult. To mount a single section, put it in alcohol on the slide, wash with a few drops of fresh strong alcohol; let most of the alcohol drain off, but while the section is still covered with it add chloroform, drain off the mixture, and pour over the still moist section a fresh dose of chloroform; if the washings have been really thorough the sections will clear at once.

MICROTOME KNIVES.—The Scientific Instrument Company of Cambridge, England, are preparing an automatic machine for sharpening microtome knives, which, it is to be hoped, may prove to be just what every microtomist so much needs.

It is easy enough to find men skilled in honing ordinary razors, but not so with the microtome knives. Numerous and repeated trials have been made among the most hopeful experts in and about Boston, but in no case have the knives been returned in an acceptable condition, and sometimes they have been much damaged or wholly ruined. The best test for the condition of the edge is to try it on the palm of the hand. A knife that will not cut a ribbon of paraffine sections .005^{mm} thick is not fit to use; the best knives should cut as thin as .001$^{mm.}$ It is not often that it becomes desirable to cut so thin, but it is important in making thick sections ($\frac{1}{50}$—$\frac{1}{100}$^{mm}) to use a knife that has a much finer working capacity. A thoroughly sharp blade may have very

nearly a horizontal position for its lower (plane) surface in sectioning, while a duller one requires to have its back raised a little above the level of its cutting edge. It is safe to say that a knife cuts well when thin sections (.005^{mm} or less) *agree in size with the cut surface of the paraffine block.* It may be possible to cut a straight ribbon with a dull knife, but in this case it will probably be found that the sections are shortened in a direction at right angles to the edge of the knife, which shows that the knife is acting the part of a plough, which crushes more than it cuts.

The statement that a sharp knife may have a nearly horizontal position must be understood to have some limitations. In general it may be said that the larger and harder the object the more imperative it becomes to have the under surface of the blade slant towards the object, and the necessity for this is greater with a transverse than with an oblique knife. For very hard objects a relatively thick-edged knife is required as well as a slanting position.

For ordinary histological or embryological work, the upper surface of the blade is ground hollow, the lower surface plane (Fig. 1 *k*), the edge being left very thin so that an extremely slight bevel is made in setting. What bevel there is should be mainly on the upper side. The edge when examined with a magnifying power of a hundred diameters should be perfectly straight and *smooth.*

FIG. 1.—Diagram illustrating the position of the knife in sharpening. *k*, knife; *s*, oil-stone; *w*, wire.

Method of Sharpening.—Microtome knives can be properly sharpened only by those who understand their chief peculiarities, and who have trained themselves in this special work. The difficulties in acquiring the art are not, however, insurmountable; for with the proper means and a little perseverance they can be mastered in a short time. The first important step is to provide oneself either with a good razor strop (those made by Zimmermann in Berlin are considered excellent), or with a long and wide oilstone of the finest quality. Strops made of a leather band, unsupported by a solid base, and kept tense by the aid of a screw working in a frame, should never be employed in sharpening these knives, for they invariably give a bi-convex edge, with which it is impossible to do fine work. To secure a *plane* bevel of the cutting edge the surface of the strop must be perfectly *smooth, flat* and *hard.* In using the strop the knife is drawn back and forth, back foremost, *without* pressure, until the edge appears sharp when tested in the manner before mentioned.

In using an oil-stone it is well to cover the surface of the stone with a mixture of glycerine (two parts) and water (one part), as recommended by Fol.[1] The blade is laid flat on the

[1] Lehrbuch d. Vergl. Mikr. Anat., p. 129, 1884.

stone and pushed *forward, edge foremost,* in such a manner that the free end of the knife finishes by resting on the more distant end of the stone. Here the blade is turned on its back and returned, edge in advance as before, to the place of starting. In drawing the blade the utmost care should be taken *never to raise in the slightest degree the back from the stone;* and *further the knife must not be pressed on the stone, but held lightly by the finger-tips,* and the *necessary friction be left to capillary adhesion.*

After drawing the knife fifteen to twenty times it should be tested as before.

The knives furnished with the Thoma microtome should be provided with a wire support (Fig. 1 *w*) for the back of the knife during the process of sharpening.

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SCIENTIFIC NEWS.

—The results of the Hudson's Bay Expedition, in 1884, under Lieut. Gordon, possess much interest, and Dr. Bell's report on the geology of the extreme northern shores of Labrador, as well as of Hudson's strait, contains new matter especially relating to the glaciation of that country. As to the botanical collections made, Prof. Macoun affirms that it shows conclusively the arctic character of the climate of the straits and that part of Labrador north of Nachvak. Raised beaches, 300–400 feet high, were observed on Hudson's strait. Ancient stone structures, erected by the Eskimo, were observed, and Dr. Bell observes: "From what I have seen of the situations which the Eskimo in various places in Hudson's bay and strait choose for their camps, there appeared to be little doubt that they had lived here when the sea-level was 20 to 30 feet higher than it is at present."

The observations made shows that the basin of Hudson's bay may have formed a glacial reservoir, receiving streams of ice from the east, north and north-west and south and south-west. The direction of the glaciation on both sides of Hudson's strait was eastward. "That an extensive glacier passed down the strait may be inferred from the smoothed and striated character of the rocks of the lower levels, the outline of the glaciated surfaces pointing to an eastward movement, the composition of the drift, and also from the fact that the long depression of Fox's channel and the strait runs from the north-westward towards the south-east, and that this great channel or submerged valley deepens as it goes, terminating in the Atlantic ocean. Glaciers are said to exist on the shores of Fox's channel and they may send down the flat-topped icebergs which float eastward through the lower part of Hudson's strait into the Atlantic. During the drift period, the glacier of the bed of Hudson's strait was probably joined by a contribution from the ice which appears to have occupied the site of Hudson's bay, and by another also from the southward, coming down the valley of the Koksok river, and its continuation

in the bottom of Ungava bay. The united glacier still moved eastward round Cape Chudleigh into the Atlantic."

Farther observations on the geology and natural history as well as ethnology of this region are desirable, and will be made during the season of 1885. The steamer *Alert*, in command of Lieut. Gordon, R. N., left Halifax, May 30, Dr. Bell being the scientist of the expedition. Stores sufficient for more than a year will be taken to provide against any emergency. The round trip is expected to occupy five months. The stations to be visited are Port Burwell, near Cape Chidleigh, Ashe inlet, near North bluff, Stupart's bay, near the Prince of Wales Foreland, Nottingham island, Digges island and Nachvak bay, all of which were founded last year. These stations will all be continued, except the last named, which will be dispensed with on the score of economy. Lieut. Gordon expected to reach Hudson's strait by June 10. Provisions for the ensuing year and eighteen tons of hard coal will be left at each station. A large quantity of evaporated vegetables will be taken to the stations. Forty applications have been made for positions as observatory men. Much valuable information is expected to be gained from the observations made during the past year as to the formation and breaking up of the ice and in regard to its movements, also relative to the navigation of the strait. After leaving Fort Churchill, a running survey will be made on such portions of the eastern shore of the bay as are practicable. The *Alert* is expected to arrive back in the strait about August 25, and the remainder of the time will be occupied in surveying as much of the coast of the strait as is possible.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES, March 24.—Mr. Garrison communicated the results of his examination of slag from an iron furnace.

Mr. A. H. Smith and Mr. Edw. Potts described borings in the vicinity. One in Cumberland county, N. J., reached a depth of 650 feet, and at 570 feet passed through a bed of oyster shells, stated by Professor Heilprin to be almost certainly Cretaceous.

Dr. Leidy spoke upon the giant extinct sloths, and stated that among fossils received last year from New Iberia, La., were three teeth, a close study of which indicated that the form described by Owen as *Mylodon harlani* should be returned to the genus Orycterotherium, in which it had been placed by its discoverer, Harlan.

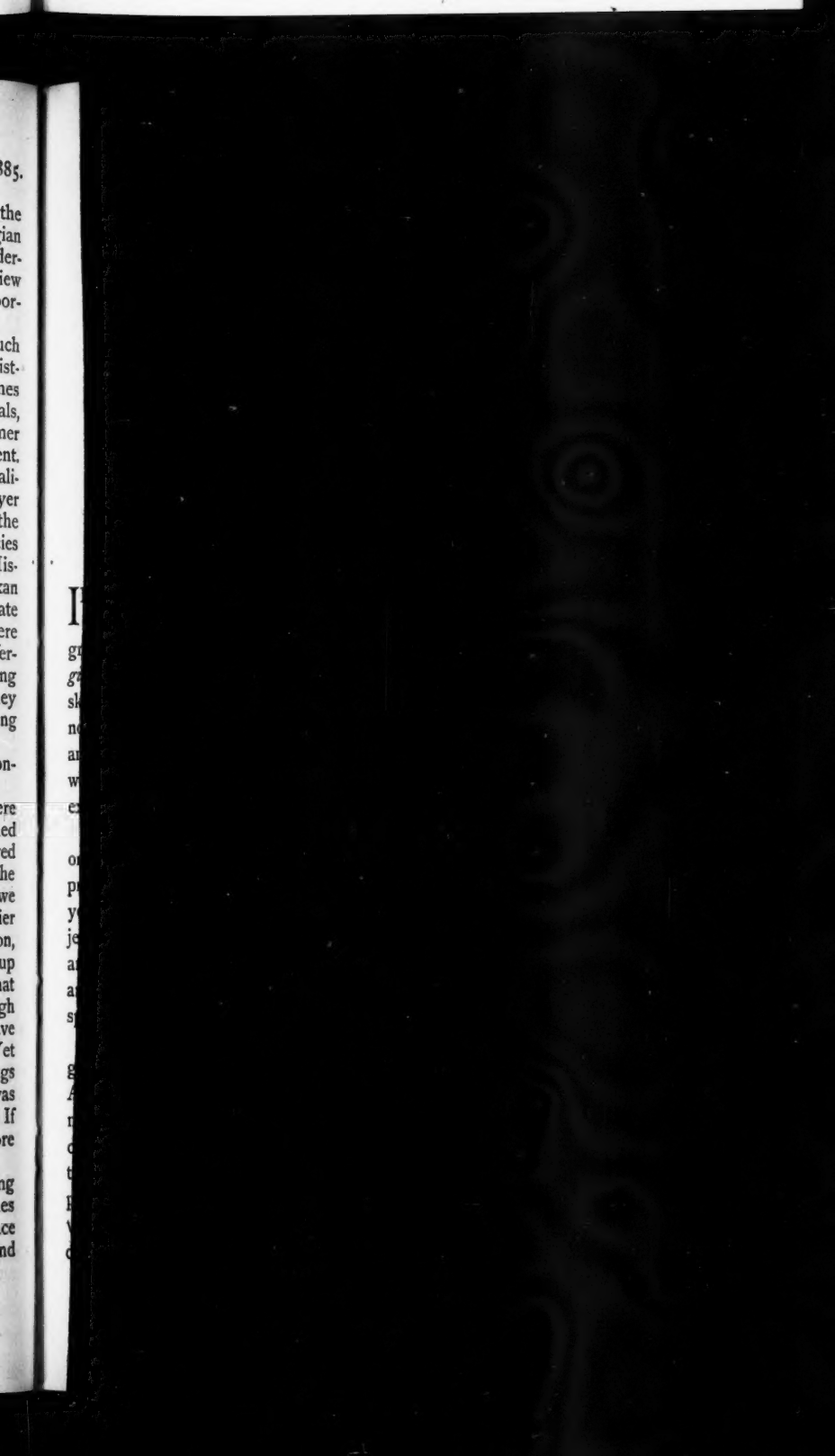
Mr. Eastlake presented Entomologia Hongkongensis, and Mr. A. F. Gentry a description of a supposed new species of Cyanocorax.

March 31.—Dr. Horn referred to certain sexual characters separating forms of the Staphylinidæ. The gradual disappearance of these forms might be considered as an instance of nature's

indication of intention. He also referred to modifications in the tarsal joints of the Silphidæ, described in a paper by a Belgian entomologist. The number of joints in tarsi and antennæ underwent gradual reduction, but the speaker considered that in view of the intermediate conditions it was ill-advised to give importance to the presence of the smaller number of segments.

Professor Heilprin believed that in Palæozoic times no such zoölogical zones as now occur existed. For instance, no existing Brachiopoda are cosmopolitan, while those of ancient times were much more widely distributed. The presence of corals, graptolites, etc., in widely separated regions, indicated the former presence of a temperature much more uniform than the present. The speaker then drew attention to points which seemed to invalidate the opposite conclusions arrived at by Professors Neumeyer and Roemer. Though not a single New Jersey species of the present day is found in the Gulf of Mexico, fifty or sixty species of fossils out of 150 from the northern locality are found in Mississippi and Alabama, while only ten out of 200 fossil Texan forms are found in Mississippi, showing conclusively that climate was not the former cause of distribution. These zones were gradually established during some period of the Tertiary. Referring to the pebbles obtained by Mr. A. H. Smith from a boring of 170 feet on Black's island, Professor Heilprin stated that they came from a glacial gravel, probably the Trenton. The boring had now, at a depth of 195 feet, reached a bed of plastic clay.

A paper entitled, Remarks on *Lanius robustus* Baird, by Leonhard Stejneger, was presented.

April 7.—Mr. Morris spoke upon the question, Why are there no fossil forms in the strata preceding the Cambrian? He called attention to the fact that the oldest animals known were covered with protective armor, but without weapons of offense. Of the predatory foes whose presence rendered this armor essential we know nothing. The armored forms probably represent earlier free-moving forms, driven to wear heavy armor for protection, and by the weight and character of the armor, forced to take up a life on the ocean bottom. It was late in the history of life that animals began to secrete an internal hard skeleton, and though the external hard covering was acquired earlier, life may have prevailed a long time before this adaptation was gained. Yet fossilization was not possible until these hard external coverings had been acquired, while the existence of large land animals was not possible until an internal skeleton had been acquired. If these conclusions are correct we can never hope to obtain more than a fragment of the antique fauna.

Dr. Leidy read a letter from Dr. Neal, Archer, Fla., announcing the discovery of another bed of fossil bones about twenty miles from that found a year ago. Two or three feet below the surface was a bed of cinders and charred bones, and above this were found fragments of the teeth of a rhinoceros, probably *R. protersu.*